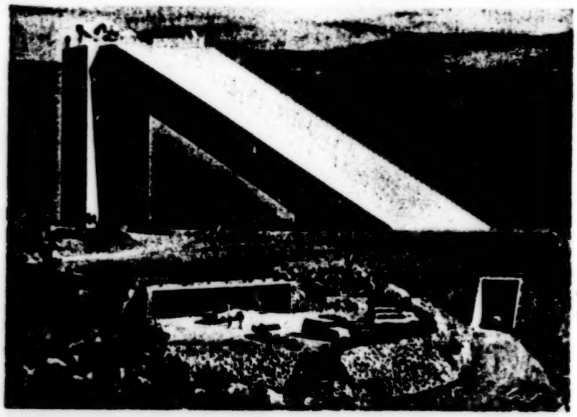
JUN 2 9 1979

Item 834-P

NS 1.20: P94/1979

NAL



National Science Foundation

COMPLETED

Guide to Programs

Fiscal Year 1979

(79)

This *Guide* provides summary information about National Science Foundation programs for fiscal year 1979; it is intended as a source of general guidance for institutions and individuals interested in participating in these programs. Program listings describe the principal characteristics and basic purpose of each activity, eligibility requirements, closing dates (where applicable), and the address from which more detailed information, brochures, or application forms may be obtained.

Any modifications to NSF's FY 1979 programs occurring after presstime for this *Guide* will be promptly announced by the Foundation. This and other information, including program schedules and deadlines (and updates when necessary) and availability of brochures describing individual programs, is regularly published in the monthly *NSF Bulletin*, which is distributed free by NSF. To receive it, write to:

Editor, *NSF Bulletin*
Public Information Branch
National Science Foundation
Washington, D.C. 20550

Discrimination Prohibited

In accordance with Federal statutes and regulations, no person, on grounds of race, color, age, sex, national origin, or physical handicap, shall be excluded from participation in or denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

National
Science
Foundation

Guide To Programs

Fiscal Year 1979

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $2.50
Stock Number 038-000-00386-1

Introduction

The National Science Foundation is an agency of the Federal Government established in 1950 to promote and advance scientific progress in the United States. The Foundation fulfills this responsibility primarily by sponsoring scientific research, encouraging and supporting improvements in science education, and fostering scientific information exchange. NSF does not itself conduct research or carry out education projects. Recipients of NSF support or assistance have full responsibility, in accordance with the terms of their grants or other agreements, for the conduct of their projects or activities and for the results produced.

The Foundation supports scientific research and education projects in the mathematical, physical, environmental, biological, social, behavioral, and engineering sciences. The Foundation does not support projects in clinical medicine, the arts and humanities, business areas, or social work.

The National Science Board is the policymaking body of the National Science Foundation. It consists of 25 members appointed by the President, by and with the consent of the Senate, and includes the Director of the Foundation who serves on a full-time basis. The Board passes on new Foundation programs and on grants or contracts requiring a total commitment of more than $2 million or an annual expenditure of more than $500,000.

Proposals for support are ordinarily assigned to the appropriate division or office for review and evaluation. An organization chart depicting the major areas of program activity is provided on page 64.

In making its decisions on proposals, the Foundation relies heavily on the advice and assistance of advisory committees, outside reviewers, and other experts to ensure that NSF is able to reach fair and knowledgeable judgments. These scientists and educators come from colleges and universities, nonprofit research and educational organizations, industry, and other Government agencies. Their counsel has proven invaluable to the Foundation.

The National Science Foundation Act of 1950, as amended, permits the Foundation to support basic research, without restriction as to the type of performer. It also permits the support of applied research at academic and other nonprofit institutions. By letter to the Director of April 13, 1972, and pursuant to the authority of Section 3(c) of the Act, the President extended the applied research authority in the following terms:

> The Foundation, in making grants or contracts for applied scientific research relevant to national problems involving the public interest, may support such work at other than academic and nonprofit institutions when the Director of the National Science Foundation determines that it would be advantageous to use the capabilities of such other institutions to accomplish the program objectives.

Within the limits of this Directive, it is the policy of the National Science Foundation to support research at industrial or commercial organizations when it is advantageous for the attainment of its program objectives.

For the support of basic research, the Foundation policy, adopted by the National Science Board in January 1978, states:

> The National Science Foundation welcomes unsolicited proposals from commercial firms. But it also wants to avoid substituting Federal support for normal commercial investment in research or compromising the vitality of research in educational institutions, where research makes a special added contribution to science education. Thus, an unsolicited proposal from a commercial firm may be funded when: (a) the project is of special concern from a national point of view; (b) special resources are available in industry for the work; or (c) the proposed project is especially meritorious.

Thus, the Foundation will continue to emphasize its traditional role of support for a strong national basic research capability, particularly in academic institutions, and the improvement of science education. At the same time, the participation of individual industrial and other nonacademic organizations with strong capabilities in scientific research is encouraged.

Collaboration on appropriate programs is encouraged between industry and university researchers, as well as between industry and State and local governments. Similarly, broader efforts through industry associations, groups of companies, or professional societies may be supported. Prospective proposers are encouraged to contact the appropriate program for program announcements and brochures and for preliminary discussions and guidance prior to the submission of a proposal.

Generally, awards are made in response to both solicited and unsolicited proposals. Normally, awards resulting from unsolicited research proposals are made on a cost-sharing or jointly funded basis, while those from solicited proposals may provide for payment of full costs, including fees. Proposals in response to specific program announcements are considered solicited only when the announcement so indicates.

Disposition of rights to data and inventions resulting from Foundation-supported research is subject to negotiation. Factors to be considered are the nature and purpose of the project and other factors involving the public interest, the commercial positions of the awardees, and any equities they may have. At a minimum, the Government will receive a royalty-free, paid-up license and the right to require the licensing of others on reasonable terms in certain circumstances.

The National Science Foundation looks forward to being able to utilize and properly integrate the capabilities of all institutions in the support of science and its contribution to society and the Nation.

Criteria for the Selection of Research Projects*

The National Science Foundation administers several different programs of research support corresponding to several legislatively assigned objectives. To the maximum degree possible, these activities are designed to utilize and enhance existing scientific research potential and institutions. Purposeful adjustments are made when indicated.

In the selection of individual projects a number of widely understood and acknowledged criteria are considered. In different programs, the different criteria must be assigned different weights, according to the objectives being pursued. Also, these criteria relate in different ways to the distinctive characteristics of different types of research-performing organizations.

INTRODUCTION

Policy Context

Public support of scientific research, specifically including *basic* research, is an accepted feature of U.S. public policy. Such support has two recognized major objectives:

- To foster and maintain basic research as an investment toward future opportunities, as insurance against unforeseeable future dangers, and as a vital element of culture:
- To bring about prompt, effective performance of applied research and problem-oriented basic research—insofar as specific needs for these can be foreseen—in the light of current understanding.

The National Science Foundation

It is not possible to make the distinction between basic and applied research a sharp one, and the Foundation is one of several Federal agencies that supports research of both kinds. The Foundation, however, is unique in its mission to foster basic research *per se* and in its responsibility for future scientific research capability. Thus, the National Science Foundation Act of 1950, as amended, authorizes "programs to strengthen scientific research potential" as well as "scholarships and graduate fellowships." The Act authorizes support both of basic and of applied research and—in combination with Presidential directive—use of an unrestricted range of performers.

---

* As approved by the National Science Board at its 167th Meeting, October 17-18, 1974, and amended at its 192nd Meeting, August 19, 1977.

Agency Objectives and Methods

The Foundation thus has been charged with advancing several different but interrelated major objectives:

- Accomplishment of basic research;
- Accomplishment of applied research in selected areas;
- Long-term maintenance and strengthening of potential to accomplish both basic and applied research in the future.

This range of objectives has been reflected in the development of several different program formats for NSF support of research. But despite the approximate correspondence of programs to objectives, it remains true that research support actions are often taken with more than a single end in view. Thus, the Foundation's method of pursuing any one objective may be modified or restricted by consideration of the others.

Functions Performed

Where research support is concerned, functions performed by the Foundation include:

— Allocation of resources to fields of science, to classes of scientific activity, or to areas of application;

— Selection of individual projects to be supported;

— Direct establishment or adjustment of institutional structures or capabilities.

CRITERIA

Allocation of resources to fields of science and to areas of application is not further discussed in this notice, but many of the criteria for individual project selection require only slight modification for use at the higher level of aggregation. Criteria for the creation or modification of institutional structures are dealt with in a separate section.

The following is an enumeration of criteria employed in the selection of research projects. To simplify later discussion, they are grouped in four categories.

Category A

Criteria relating to competent performance of research—the technical adequacy of the performer and of his institutional base:

1. The scientist's training, past performance record, and estimated potential for future accomplishment;
2. The scientist's demonstrated awareness of previous and alternative approaches to his problem;
3. Probable adequacy of available or obtainable instrumentation and technical support.

Category B

Criteria relating to the internal structure of science itself:

4. Probability that the research will lead to important discoveries or

valid, significant, and conceptual generalizations within its field of science or (in most favorable cases) extending to other fields as well;

5. Probability that the research will lead to significant improvements or innovations of investigative method—again with possible extension to other fields of science.

Category C

Criteria relating to utility or relevance:

6. Probability that the research can serve as the basis for new invention or improved technology;
7. Probable contribution of the research to technology assessment—i.e., to estimating and predicting the direct and indirect, intended and unintended effects of existing or proposed technologies;
8. Identification of an immediate programmatic context and user of the anticipated research results.

Category D

Criteria relating to future and long-term scientific potential of the United States:

9. Probable influence of the research upon the capabilities, interests, and careers of participating graduate students, postdoctoral associates, or other junior researchers;
10. Probability that the research will lead to radiation and diffusion, not only of technical results, but also of standards of workmanship and a tradition of excellence in the field;
11. Anticipated effect upon the institutional structure of U.S. science.

Because none of these considerations is susceptible to precise quantification, or even in most cases to unambiguous rank ordering, it would be more accurately descriptive to speak not of "criteria" but rather of "factors considered." Moreover, very different relative weights must be attached to the different factors in the case of different agency objectives or programs, as is explained in a later section.

Discussion

The first three criteria—those relating to competent execution—are given first consideration in every program. Every NSF-supported project is expected at the least to produce some valid new information or relationships. The best way to ensure this is to insist upon competent scientists and adequate facilities. All other considerations which follow, then, are predicated upon the assumption that these first three criteria are universally applied and that competent performance will be the normal expectation.

Criteria 4 and 5—those relating to the internal structure of science—summarize succinctly what the scientific community understands by the phrase "intrinsic scientific merit."

Criteria 6 and 7—those relating to utility or relevance—cannot be made entirely distinct from the preceding two, since that science judged best by internal standards has almost invariably turned out in the long run to be the most useful. Valid generalizations and powerful methods of observation and measurement usually lead to new invention, improved technology, and more confident assessment. Conversely, applied investigations designed to support invention, technology, and assessment tend to succeed in these purposes to the extent that they do uncover valid generalizations or improved methods. Thus, differences between the two types of criteria are mainly ones of motivational specificity and time horizon. Research is properly termed "applied" when we visualize using the results in a very specific context—usually defined in terms of some already-formulated systems concept—or when we expect it will prove diagnostic of some already-recognized problem.

This specific relationship of applied research to a particular systems concept and plan of development is made still more explicit in criterion 8.

Criteria 9, 10, and 11—those relating to long-term scientific potential—address not so much the content of the research as the circumstances under which it is performed. They include, of course, the quality of training of scientists, but extend beyond this to the processes of scientific communication and publication, the evolution of traditional scientific disciplines, the manner in which scientific careers are developed, the organizational structures and settings in which all this goes on, and in general how the scientific tradition and the living corps of scientific capability of our Nation are maintained. While these criteria are seldom dominant in project selection or program development, they are always considered. The policy of the Foundation is not to undertake for short-term reasons any action which would seriously jeopardize the long-range science potential of the Nation.

RELATIONSHIP TO SOME CHARACTERISTICS OF RESEARCH-PERFORMING ORGANIZATIONS

NSF policy is to use and reinforce proven strengths of U.S. scientific institutions. These institutions include organizations of different types, such as:

- Universities and colleges;
- Industrial research laboratories or organizations and in-house laboratories of Federal agencies;
- National Centers and other federally funded research centers;
- Vendors of R&D services.

The Foundation seeks to avoid inadvertently changing the characteristics of proven organizations—either through individual actions, or as the cumulative result of many actions. Purposeful changes may occasionally be encouraged for specific reasons. Some relevant characteristics of the different types of organization include the following:

- Universities and colleges (academic institutions proper) have as their two principal missions teaching and the development and propagation of new knowledge and understanding. As applied to these organizations, therefore, criteria 9 and 10 may be regarded as criteria of "mission relevance."

- Academic organizations, traditionally, are deeply committed to considerations of intrinsic scientific merit (criteria 4 and 5) in developing and selecting their own research programs. This is largely a consequence of peer evaluation and peer pressure exerted upon the individual scientist.

- Organization along disciplinary lines is a prominent feature of academic research tradition. This is an indispensable virtue insofar as it guarantees comprehensive peer evaluation of scientific research *results*, but it presents some limitations for problem-oriented research. It should be borne in mind that new disciplines emerge from time to time and that the focus of established disciplines evolves continually.

- Academic environments also tend to place extreme value upon originality, methodological elegance, and upon the initiative and scientific judgment of the individual investigator. This characteristic again presents some limitations for problem-oriented research.

- Industrial research laboratories or organizations and Federal agencies' in-house laboratories generally have as their mission the generation of new knowledge and understanding in areas judged to be of immediate or potential concern and use in carrying out the commercial activities of the parent company or the mission of the agency.

- National Centers and federally funded research centers have as their mission the generation of new knowledge and understanding judged to be needed or desirable in the public interest. These organizations are generally established to provide specialized research environments not readily obtainable in organizations of the other types.

- Vendors of R&D services include many of the "not-for-profit" R&D organizations and also a number of—usually more specialized—R&D companies. These organizations, in addition to maintaining some level of independent research, are unique in the extent to which they undertake contract research on topics and problems designated by outside purchasers. Collectively they constitute a reservoir of general purpose research capability.

Discussion

Different factors tend to determine the scope and complexion of the research programs in the different types of organizations. Thus, universities tend to be complement limited. For them, the primary management decision is how many professional staff (faculty) to employ and which particular ones. Subsequently, these individuals determine program content. Industrial and mission agency in-house laboratories are "mission determined." That is, activity is weighed and selected according to mission requirements. Finally, R&D vendors are, at least to some extent, capability and market limited. Foundation policy is to recognize and, generally, to avoid disturbing these characteristic differences.

THE NSF OFFICE OF SMALL BUSINESS RESEARCH AND DEVELOPMENT

The National Science Foundation has established an Office of Small Business Research and Development, mandated in the Foundation's fiscal year 1977 Authorization Act. NSF's programs are of potential interest to those small business concerns with strong scientific research or technical capabilities.

The primary purpose of the new office is to facilitate communication between the science- and technology-based component of the small business community and NSF's programs and offices that award grants or contracts. The new office normally will not sponsor program type grants or contracts nor will it procure goods and services for other Foundation programs. Among other things, the new office will:

- Assist individual small businesses to obtain information about programs, policies and procedures of NSF, and the procedures for submitting proposals to NSF.
- Collect, analyze, compile and periodically publish information on grants and contracts awarded by NSF to small business.
- Recommend such changes as may be needed in the procedures and practices of the Foundation that would enable NSF to draw more fully on the capabilities of the science- and technology-based small business community.

For additional information that may be helpful to small businesses, contact:

Director, Office of Small Business Research and Development
National Science Foundation
Washington, D.C. 20550

CONTENTS

INTRODUCTION iii

CRITERIA FOR THE SELECTION OF RESEARCH PROJECTS v

THE NSF OFFICE OF SMALL BUSINESS RESEARCH AND DEVELOPMENT ix

I. MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING; BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES 1

- Mathematical Sciences 1
- Computer Research 2
- Physics 2
- Chemistry 3
- Engineering 4
- Engineering Research Initiation Grants 5
- Materials Research 5
- Physiology, Cellular, and Molecular Biology 6
- Environmental Biology 7
- Behavioral and Neural Sciences 8
- Social Sciences 8
- Doctoral Dissertation Research 9
- Industry/University Cooperative Research 9
- Research Initiation in Minority Institutions 10

II. ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES 13

- Astronomical Sciences 13
  - Astronomy Project Support 13
  - National Astronomy and Ionosphere Center 14
  - Kitt Peak National Observatory 15
  - Cerro Tololo Inter-American Observatory 15
  - National Radio Astronomy Observatory 16
  - Sacramento Peak Observatory 17
- Atmospheric Sciences 17
  - Atmospheric Sciences Project Support 18
  - Global Atmospheric Research Program 18
  - Climate Dynamics 19
  - National Center for Atmospheric Research 19
- Earth Sciences 20
  - Earth Sciences Project Support 20
  - Ocean Sediment Coring Program 21
- Ocean Sciences 21
  - Oceanography Project Support 22
  - International Decade of Ocean Exploration 23

- Oceanographic Facilities and Support 23
- Polar Programs 24
  - U.S. Antarctic Research 24
  - Arctic Research 25

III. SCIENCE EDUCATION 27

- Science Education Resources Improvement 29
  - Comprehensive Assistance to Undergraduate Science Education .. 29
  - Minority Institutions Science Improvement 29
  - Local Course Improvement 30
  - Instructional Scientific Equipment 30
  - Information Dissemination for Science Education 30
  - Resource Centers for Science and Engineering 30
- Scientific Personnel Improvement 31
  - Graduate and Postdoctoral Programs 31
    - Graduate Fellowships 31
    - Minority Graduate Fellowships 32
    - National Needs Postdoctoral Fellowships 32
    - Minority Institutions Graduate Traineeships 32
    - NATO Postdoctoral Fellowships in Science 32
    - Travel Grants for NATO Institutes 33
  - Faculty Improvement Programs 33
    - College Faculty Short Courses 33
    - Pre-College Teacher Development 33
    - Science Faculty Professional Development 34
  - Student-Oriented Programs 34
    - Secondary School Student Science Training 34
    - Undergraduate Research Participation 34
    - Student-Originated Studies 34
  - Minorities, Women, and the Physically Handicapped in Science .. 35
    - Women in Science 35
    - Minorities in Science 35
    - Physically Handicapped in Science 35
  - Science Education Development and Research 36
    - Development in Science Education 36
    - Research in Science Education 36
    - Joint NIE-NSF Research Program 36
    - Continuing Education for Scientists and Engineers 37
  - Science and Society 37
    - Public Understanding of Science 38
    - Ethics and Values in Science and Technology 38
    - Science for Citizens 39

IV. APPLIED SCIENCE AND RESEARCH APPLICATIONS 41

- Problem Analysis 42
- Integrated Basic Research 42
- Applied Research 43
  - Applied Social and Behavioral Sciences 43
  - Applied Physical, Mathematical, and Biological Sciences, and Engineering 44
- Problem-Focused Research Applications 44
  - Earthquake Hazards Mitigation 45
  - Chemical Threats to Man and the Environment 45

- Alternative Biological Sources of Materials 46
- Community Water Management 46
- Intergovernmental Science and R&D Incentives 46
  - Intergovernmental Program 47
  - Industrial Program 47

V. SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS 49

- Policy Research and Analysis 49
  - Socioeconomic Effects of Science and Technology 49
  - Innovation Processes and Their Management 49
  - Environment, Energy, and Resources Studies 50
  - Technology Assessment 50
- NSF Planning and Evaluation 50
- Science Resources Studies 51
  - Scientific and Technical Personnel 51
  - Funding of Science and Technology 51
  - Modeling and Special Science and Technology Indicators 51
- Information Science and Technology 52
  - Fundamental and Advanced Research 52
  - Research on Information Systems 53
- International Cooperative Scientific Activities 53
  - Cooperative Science Programs 54
  - United States-Africa Cooperative Science 54
  - United States-Australia Cooperative Science 54
  - United States-Republic of China Cooperative Science 55
  - United States-East Asia Cooperative Science 55
  - East Europe Cooperative Science Programs: Romania, Hungary, Czechoslovakia, Bulgaria 56
  - United States-France Cooperative Science 56
  - United States-India Exchange of Scientists 57
  - United States-Israel Binational Science Foundation 57
  - United States-Italy Cooperative Science 58
  - United States-Japan Cooperative Science 59
  - United States-Latin America Cooperative Science 59
  - United States-Republic of Korea Cooperative Science 60
  - United States-New Zealand Cooperative Science 61
  - Other International Programs 61
    - Scientific Organizations and Resources 61
    - Scientists and Engineers in Economic Development 62
    - Special Foreign Currency Programs 62
    - International Travel Support 63

NSF Organization Chart 64

I. Mathematical and Physical Sciences, and Engineering Biological, Behavioral, and Social Sciences

The support of individual research projects in (1) Mathematical and Physical Sciences, and Engineering; (2) Biological, Behavioral, and Social Sciences; and (3) Astronomical, Atmospheric, Earth, and Ocean Sciences (discussed in Chapter II) has the objective of increasing our store of knowledge in these fields and enhancing our understanding of the scientific aspects of major problems confronting the Nation. Most of the research supported is basic in character, although some work of a more applied nature is also supported. Support may also be provided for research workshops, symposia, publications and monographs, conferences, the purchase of scientific equipment for research purposes, the construction of specialized research facilities, and travel to selected international meetings.

To provide reasonable assurance of long-term support for continuing projects of high scientific merit, funding may be provided for periods up to 60 months in annual increments contingent upon the availability of the funds and satisfactory progress of the research.

Institutions are required to share in the cost of each unsolicited research project supported by an NSF grant or contract.

Before submitting a proposal for research support, the brochure *Grants for Scientific Research* should be consulted for guidance in preparing the application. A recommended format is provided in the brochure, but standard application forms are not required.

Eligibility

The most frequent recipients of support for basic scientific research projects are academic institutions and nonprofit research institutions. In special circumstances, such as stated in the NSF policies in the Introduction, grants also are awarded to other types of institutions and to individuals. In these cases, preliminary inquiry should be made to the cognizant program officer before a proposal is submitted. Support may be provided for projects involving a single scientist or for projects covering the activities of a number of scientists. Awards are made for projects confined to a single disciplinary area and for projects which cross or merge disciplinary interests.

Deadlines

Proposals may be submitted at any time. Approximately 6-9 months should be allowed for consideration of a proposal. Proposals to be funded in a particular fiscal year (ending September 30) normally should be received no later than January of that year.

Additional Information

Requests for further information should be addressed to the respective division director, National Science Foundation, Washington, D.C. 20550.

Research areas of NSF programs in the Astronomical, Atmospheric, Earth, and Ocean Sciences are found in Chapter II of this *Guide*.

The research areas of NSF programs in the Mathematical and Physical Sciences, and Engineering and in the Biological, Behavioral, and Social Sciences are summarized below.

Mathematical Sciences

- **Classical Analysis**—Properties, behavior, and solution of ordinary and partial differential equations; special functions; theory of approximation; theory of functions of one and several complex variables.

- **Geometry, Topology, and Foundations—**Differential and topological structure and properties of manifolds; simplified and new algebraic and analytic techniques for their investigation; topological groups and semigroups; topological dynamics; general topology; finite geometries; foundations of set theory; recursion theory; model theory.
- **Applied Mathematics and Statistics—**Mathematical descriptions, consequences, and interpretations of phenomena (i.e., the application of mathematical techniques to the understanding of real-world phenomena as organized into the physical, biological, and social sciences and engineering); the devising of new mathematical structures to implement the above procedure (for example, the development of methods of perturbing solutions of partial differential equations to solve problems in the flow of compressible fluids); statistical techniques for the analysis of observational and experimental data gleaned from physical, biological, and social phenomena.
- **Modern Analysis and Probability—**Structure of Banach spaces; Banach algebras, particularly C*-algebras and von Neumann algebras; mathematical physics; linear and nonlinear functional analysis; operator theory; group representations and abstract harmonic analysis; ergodic theory; probability theory.
- **Algebra and Number Theory—**Algebraic structures (semigroups, groups, fields, commutative algebra, associative rings and algebras, nonassociative rings and algebras, etc); lattices; ordered algebraic structures; number theory; polynomials; algebraic geometry; linear and multilinear algebra; category theory; homological algebra; combinatorics and graph theory.

Computer Research

- **Theoretical Computer Science—**Theory of computation, numerical analysis, and computational mathematics; theory of formal languages; analysis of algorithms; other topics concerned with the theoretical foundations of computer science.
- **Software Systems—**The conceptual basis for the specification of future software systems, including advanced programming languages and optimizing compilers, the analysis of program structure to support verification and proof of correctness of programs, and the study of algorithms both to discover new algorithms and to find improved measures of effectiveness of known algorithms.
- **Software Engineering—**The structure and design process of computer software, especially the verification, testing, portability, reliability, and human interfacing to numeric and nonnumeric software systems. Areas of emphasis include program validation and testing by using software tools; human factors in software design and use; prototypes or experimental implementations.
- **Intelligent Systems—**Computer-based systems which have some of the characteristics of intelligence. Relevant areas include pattern recognition, pattern generation, knowledge representation, problem solving, natural language understanding, theorem proving, and others which relate to the automatic analysis and handling of complex tasks.
- **Computer Systems Design—**Understanding the organization of computer systems; designing computer systems that will operate correctly when some parts have failed; alternate hardware configurations and software algorithms to improve the human/computer interface; computer graphics.
- **Special Projects—**New computer applications and general issues that may have social impact or could be helpful in solving special problems and providing new opportunities for technology. Topics include, but are not limited to, computers and society, computer privacy and security, data bases, modeling, and networking.

Physics

- **Elementary Particle Physics—**The discovery of unknown states of matter and the determination of their properties and interactions; accumulation of data that can be compared with theoretical models and ideas regarding the nature of the submicroscopic world. Support is primarily provided to university groups to conduct experimental research at the major accelerator centers at national laboratories or at specialized university-based or university-affiliated laboratories.

- **Nuclear Science**—The structure of atomic nuclei; nuclear decay and radioactivity; nuclear reactions and scattering; the relationship between the above properties and other natural phenomena.
- **Nuclear Physics**—Nuclear research below about 150 MeV, conducted largely by in-house researchers using their own accelerator facilities; basic research in areas where nuclear science has a major impact on other sciences; development of heavy-ion accelerators and ion sources.
- **Intermediate Energy Physics**—Nuclear research at high-energy accelerators and at intermediate energy accelerators (above about 150 MeV), conducted largely in the user-group mode; development and operation of accelerators in the intermediate energy range; tests of new accelerator concepts.
- **Atomic, Molecular, and Plasma Physics**—Properties and interactions of particles at the atomic, molecular, and more complex aggregation levels in which the atomic characteristics dominate. Specific interests include: measurement of precisely defined states of atoms and the interaction of these states with other such atoms; formation and properties of highly perturbed electronic configurations in light and heavy atoms; study of the complex states formed during close collisions of heavy atoms; ultraprecise measurements of atomic properties to verify basic theories and find expressions of new physical laws; general and collision-free plasmas.
- **Theoretical Physics**—Development of quantitative hypotheses to interpret results of experimental physics and to suggest new directions for research on the properties of physical systems from nuclei to stars. Emphasis is on particle theory, nuclear theory, and atomic theory.
- **Gravitational Physics**—Aspects of the explosive creation of the universe, its present dynamical evolution, and its ultimate fate; strong gravitational fields of X-ray sources, neutron stars, and black holes; fine details of weak gravitational fields; gravitational radiation; gravitational interaction with quantum mechanics and particle theory.

Chemistry

- **Structural Chemistry and Thermodynamics**—Equilibrium and time-dependent macroscopic thermodynamics and statistical mechanics; macroscopic properties of matter; intermolecular interactions in condensed phases; properties of colloidal systems and surfaces; high temperature chemistry; new methods for structure determination; determination and interpretation of the geometrical parameters of chemical species by spectroscopic and diffraction methods.
- **Quantum Chemistry**—Development of a general chemical theory to aid in the design and interpretation of experimental studies; experimental chemical transformation studies of single collisions of atoms and molecules; acquisition and interpretation of data on the interaction of radiation with atoms and molecules; energy transfer within and between individual molecules.
- **Chemical Dynamics**—Rates of reactions that are critically important in developing general laws and theories in chemistry; influence of chemical environments, energy sources, and catalysis on rates and products of chemical reactions; transient intermediates produced in reacting systems and their roles in producing chemical changes; correlations and generalizations between molecular structure and reactivity; new techniques and instruments to allow the above research to be conducted; fundamental rate data to disciplines such as biology and atmospheric sciences.
- **Chemical Analysis**—New or improved methods for analyzing surfaces, especially dirty surfaces; comprehensive approaches to the analysis of complex materials; analytic techniques that couple novel chemistry, advanced instrumentation, and computer management; more sensitive, selective, accurate, and precise methods of chemical analysis.
- **Synthetic Inorganic and Organometallic Chemistry**—Mechanisms of homogeneous (soluble) catalysis; new metallic and organic compounds possessing catalytic behavior.
- **Synthetic Organic and Natural Products Chemistry**—How chemical reactions can be used to modify or change organic molecules; new methods of synthesizing complex molecular structures; synthesis of complex natural molecules.
- **Chemical Instrumentation**—Assistance to universities and colleges in acquiring major items of instrumentation essential for conducting research, including those that can be used by groups of investigators as well as more highly

specialized equipment required by a single investigator.

Engineering

- **Automation, Bioengineering, and Sensing Systems—**Systems for advanced automation and bioengineering, including research on new sensing systems, pattern analysis and processing, feature extraction, decision theory, control devices, laser systems, remote sensing, imaging systems, and controlled manipulators.
- **Devices and Waves—**Investigations of new concepts in electrical components and systems, novel fabrication techniques, improved methods for analyzing device behavior, extensions of device operation into new parameter domains; semiconductor, quantum electronic, magnetic, acoustic, and superconducting devices; electromagnetics; plasma and beam dynamics; high speed, high performance, and small size frontiers in solid state electronic and laser components; nonlinear wave phenomena in plasma and other media and systems.
- **Electrical and Optical Communications—**Devices and circuits to produce such functions as generation, modulation, and detection by optical means; integrated optics; performance of atmospheric optical communication systems under poor weather conditions; codes for the transmission and reception of images and pictures and their implementation in low-cost, large-scale, digital, integrated electronic circuits; image generation, transmission, reception, and processing; large-scale computer communications networks.
- **System Theory and Applications—**Mathematical methods that are used in engineering to analyze complex systems of equipment, that are used in operations research to analyze large-scale operations, and that are useful to those who deal with sociotechnological problems.
- **Chemical Processes—**Basic understanding of the synthesis, reaction rate, selectivity, optimization, and control of chemical processes undergirding a wide range of process industries, with emphasis on catalysis; kinetics and reaction engineering; process synthesis, simulation, and control; polymerization and polymer processing; sensor development; electrochemical and biochemical processes.
- **Heat Transfer—**Mechanisms of heat transfer and the physical laws that govern thermal energy transport; quantitative tools to design thermal systems and to harness the strategic manipulation of thermal energy; nucleate boiling at small temperature differences; general correlations for rough and extended surfaces; compact heat exchanger surfaces; theoretical models of the processes that occur during heat transfer in combustion, and evaluation of the models; roles and interactions of transport processes in thermal insulation systems.
- **Engineering Energetics—**Arc-heater reactor design for chemical processing; arc-heater dynamics; chemical and physical behavior of burning coal, oil, gas, and other materials; characterization of flames; air pollution control and combustion efficiency; problems associated with substitute fuels; basic phenomena in magnetohydrodynamics and thermionic energy conversion.
- **Thermodynamics and Mass Transfer—**New techniques for obtaining new levels of precision in thermodynamics and transport property studies; data for extreme conditions of temperature and/or pressure; the nature of unusual states, such as gas hydrates; a predictive capability for multicomponent mixtures based on modern solution theory; mass transfer through microporous structures; techniques and theory to describe interfacial transport properties; mass transfer in biosystems; fundamental studies of food processing using basic engineering principles.
- **Particulate and Multiphase Processes—**Colloidal, interfacial, and hydrodynamic behavior of dispersed solids (colloids, slurries, and aerosols), liquids (emulsions and mists), and gases (froths and foams); physics, chemistry, and engineering principles governing the solid processing operations such as generation, size modification, transport, classification, and separation.
- **Structural, Materials, and Geotechnical Engineering—**Analytic and synthetic principles and laboratory and field experimentation supportive of the design and construction of fixed facilities and the operation of resource acquisition systems at surface and subsurface levels. Subdisciplines supported include structural engineering and mechanics, construction materials, soil mechanics, and rock mechanics. Topical areas of research include optimization, probabilistic approaches, site characterization, offshore structures, high strength concretes, and

geotechnical in-situ instrumentation and centrifuge experiments.

- **Fluid Mechanics**—Biomechanics, hydrodynamics, stability and turbulence, and viscous flow, with emphasis on transition to turbulence and organized structure in turbulence, microhydrodynamics of free particles in flow fields, and hydrodynamic information for shallow water ship maneuvering characteristics.
- **Solid Mechanics**—Mechanical behavior of solid materials used in such fields as general engineering, bioengineering, agricultural engineering, and food processing, with emphasis on how solids degrade and fail, changes in material properties after exposure to a given loading or environmental history, and how the load and deformation are distributed through a structural component.
- **Water Resources, Urban and Environmental Engineering**—Mechanics of jets and plumes; fundamental investigations of phenomena involved in the overland flow of water; multiphase water flow through porous media; wind-wave interactions; erosion and transport of sediments in water; transport diffusion and removal of pollutants; dynamics of waste water treatment processes; water purification processes; estuarine mechanics.
- **Research and Resource Facility for Submicron Structures**—A new facility is now in operation at Cornell University that provides the equipment and expertise needed to fabricate structures that have features that are less than a micrometer in length. The facility is available for use by qualified members of the national research community who wish to explore small structure frontiers in solid state electronics, integrated optics, superconducting devices, biomedical instrumentation, and other technical areas. Included in the resources of the facility will be a computer-controlled electron beam pattern generating system and thin film growth, processing, and characterization systems. Researchers from each of the engineering and scientific disciplines are encouraged to explore the potentialities that such a facility might have in advancing their fields.

Engineering Research Initiation Grants

The National Science Foundation is charged, in part, with initiating and supporting basic research and programs to strengthen research potential in engineering and to appraise the impact of engineering research upon industrial development and upon the national welfare. In response to those needs, the Foundation seeks to provide opportunities in engineering research to new investigators through an Engineering Research Initiation Grants program.

Eligibility

This program is directed toward full-time engineering faculty members who are at the professorial level and have had no substantial research support. Applicants are encouraged to submit proposals in areas which will expand their research capabilities beyond the research done for the Ph.D. degree. Grants, awarded on a competitive basis, are to be used for the initiation of theoretical and/or experimental research projects in any area normally supported in the Division of Engineering and in the Metallurgy and Materials section of the Division of Materials Research.

Deadlines

Instructions for preparing engineering research initiation proposals are available in early October from the above offices of the National Science Foundation, Washington, D.C. 20550. Request the *Engineering Research Initiation Grants* brochure. Proposals must be postmarked on or before November 15, 1978, to be eligible for consideration.

Materials Research

- **Solid State Physics**—Experimental research on metals, semiconductors, and insulators in the crystalline state, the amorphous state, and intermediate states of disorder, involving studies of phase transitions and critical point phenomena as well as electronic, magnetic, and lattice structures and their excitations. Important areas include studies of physical phenomena at surfaces and interfaces; photon, electron, and neutron scattering from solids; transport properties; resonance studies; and nonlinear phenomena. Emphasis is on developing the basic physical understanding of the system and phenomenon under investigation.
- **Solid State Chemistry**—Experimental stud-

ies of organometallic solids, molecular and ionic crystals, and liquid crystals, with emphasis on properties characteristic of the system as a whole. Important areas of activity include solid state synthesis, in part with the aim of achieving given properties or of testing various theories; solid state reaction mechanisms; electrical and magnetic properties, including superionic conductivity; structural and ionic defects; energy transport; and chemisorption and related surface studies.

- **Low-Temperature Physics**—Experimental research on condensed matter which requires low temperature in an essential way; e.g., studies of systems in which the effects of quantum mechanics are manifest in macroscopic properties such as super conductivity and superfluidity of both isotopes of helium; research on quantum crystals; electronic, magnetic, and lattice dynamic properties of crystalline and amorphous systems at ultralow temperature.
- **Condensed Matter Theory**—Theoretical research on condensed matter involving studies of phase transitions and critical point behavior, elementary excitations, lattice dynamics, defects, surfaces, electronic and magnetic states, transport and optical properties, and macroscopic quantum properties such as superconductivity and superfluidity.
- **Metallurgy**—Elastic and plastic deformation, creep, fatigue, fracture, defects, deformation processing, and hydrogen embrittlement of metallic materials; corrosion, erosion, oxidation, wear, phase transformations, physical properties, extractive and chemical metallurgy, solidification, structural characterization, thermodynamics, and phase equilibria of metallic materials.
- **Polymers**—Synthesis of new types of polymers; new methods of producing polymers; basic structures of certain classes of polymers at the molecular level and in aggregates of molecules; relationship among mechanical properties and structure; deformation, fatigue, and fracture of polymers; development of polymers with superior strength and impact; polymers as synthetic implant materials.
- **Ceramics**—Fundamental properties of ceramic materials, including refractory oxides, nitrides, carbides and other inorganic compounds, glass, semiconductors, graphites, and superconducting intermetallic compounds; deformation and fracture mechanisms in severe environments; synthesis and physical properties of new classes of materials, such as intercalated graphite compounds.
- **Materials Research Laboratories**—Major interdisciplinary laboratories designed to complement individual research funding by undertaking programs of a scope or complexity not normally feasible under traditional support. Essential activities include the development and operation of central experimental facilities for the joint use of faculty and students, major cooperative research programs in important materials problems or problem areas, and seeding of novel materials research concepts and ideas.
- **National Magnet Laboratory**—Maintains and operates facilities for providing extremely high magnetic fields, develops new and improved magnets, and carries out research utilizing high magnetic fields. The magnet facilities are available for experiments by qualified users, both NML staff and visiting researchers. High resolution nuclear magnetic resonance facilities are also under development.
- **Synchrotron Radiation**—Support for the synchrotron radiation facilities at Wisconsin and Stanford provides qualified users engaged in studying all forms of matter with an extremely intense source of continuous electromagnetic radiation reaching into the far ultraviolet and X-ray regions of the spectrum.

Physiology, Cellular, and Molecular Biology

Proposals dealing with research involving *in vitro*-generated recombinant DNA should take into account the guidelines adopted by the Department of Health, Education, and Welfare and outlined in the July 7, 1976, *Federal Register* (Vol. 41, No. 131, Part 2, pp. 27902-27943).

- **Biochemistry**—Molecular basis of enzyme catalysis and the events associated with the chemical changes of constituents of biochemical reactions; chemical interactions of macromolecules and their interactions to form supramolecular structures, including subcellular organelles.
- **Biophysics**—Development and interpretation of data that enhance understanding of the molecular changes that occur in macromolecular compounds (biopolymers) during their func-

tional processes; development and adaptation of instrumentation that provides increased sensitivity and capability for measuring the detailed molecular structure, dynamics, interactions, and alterations in these properties that occur during the functional state.

- **Developmental Biology**—The biological life span of animals, plants, and microorganisms, including fertilization, mechanisms of cell division, cellular and tissue interactions, gene control in higher organisms, the ultrastructure of cells, and the development of specialized cell functions, with emphasis on multicellular organisms.
- **Regulatory Biology**—Characteristics and evolution of mechanisms, such as endocrine and neuroendocrine systems, which initiate, integrate, and regulate physiological functions in tissues, organs, and organisms.
- **Metabolic Biology**—Biochemical processes in animal, plant, and microbial systems by which energy is provided and through which material is assimilated and broken down, including photosynthesis and nitrogen fixation, ion transport across membranes, oxidative phosphorylation, chemiosmotic systems, the elucidation of metabolic pathways, and the role of natural products in plant function.
- **Genetic Biology**—Organization, transmission, function, and control of hereditary information, including recombinant DNA research; genetic control of assembly of viruses; control of gene expression; the packaging and fundamental structure of the genetic material; the division of labor between the genetic material as it is distributed among the cell organelles, nucleus, chloroplasts, and mitochondria; application of molecular mechanisms to plant cell biology and crop research.
- **Human Cell Biology**—Collaborative, multidisciplinary research on the structure and organization of cell surfaces and genetic material and the molecular aspects of intracellular regulation to enhance understanding of the mammalian cell, particularly the human cell.
- **Cell Biology**—Experimental studies on prokaryotic and eukaryotic organisms and cells in tissue culture; cell ultrastructure and function; intercellular interactions. Areas of emphasis include the cytoskeleton—cell division, motility contractility, cell-cell interaction; structure and function of membranes and cytoplasmic organelles and communication of effector ions and molecules; chromosome structure and function, nuclear-cytoplasmic interrelationships, and the biology of the immune response.

Environmental Biology

- **Ecology**—Community ecology of land, inland water, and soil habitats, with emphasis on interspecific interactions such as competition, herbivory, pollination and predation, other antagonisms and symbioses in natural and agricultural ecosystems, and coevolution within interacting groups; analysis of multiple-species assemblages using the identical food source or microhabitat; mechanisms that influence the distribution and abundance of communities of animals and plants now and in the recent geological past.
- **Ecosystem Studies**—Laboratory, field, and mathematical modeling studies leading to basic information on processes and components of natural, managed, and man-dominated terrestrial, freshwater, and wetland ecosystems; new methodologies to provide acceptably accurate predictions of ecosystem change and allow detailed mathematical analysis of functional interdependencies in complex, highly variable systems; acquisition of basic ecosystem research information to solve pressing problems of ecosystem management and exploitation.
- **Systematic Biology**—Information on the identities, relationships, and distributions of living species of plants, animals, and microorganisms; organic changes through the course of the Earth's history by studying fossil remains of extinct species. Areas of research include functional morphology, chemosystematics, tropical biology, and paleobiology.
- **Research Resources**—Ensuring that living-organism stock centers, biological field research facilities, and systematic research collections are available for use by U.S. scientists.
- **Population Biology and Physiological Ecology**—General principles that describe the physiological adaptations of animals and plants to their respective microenvironments; life histories of plants and animals in terms of evolutionary biology and natural selection; evolutionary and ecological significance of specific patterns of social behavior, territoriality, and mate selection; theoretical models for ecological genetics; adaptive significance of genetic variability, including the study of the

physiological aspects of genetically determined enzyme variability.

Behavioral and Neural Sciences

- **Anthropology**—Cultural and social anthropology, archaeology, and physical anthropology. All topics, geographic areas, and methodologies; systematic research collections; archaeometry; origins. The interest is in problem-specific scientific research.
- **Linguistics**—Syntactic, semantic, phonological, and phonetic properties of individual languages and of language in general; acquisition of language by children; psychological processes in the production and perception of speech; biological foundations of language; social influences on and effects of language and dialect variation; formal and mathematical properties of language models.
- **Neurobiology**—All aspects of nervous systems, their function and development, whether at the molecular, cellular, physiological, or behavioral levels; neuroanatomy, neurochemistry, neuroendocrinology, neurophysiology, and neuropsychology.
- **Sensory Physiology and Perception**—All aspects of sensory-perceptual systems, including various mechanisms of energy transduction, neural coding and transmission, information extraction, and the resulting behavior and perceptual phenomena; development of sensory systems or perceptual behavior.
- **Memory and Cognitive Processes**—Development and utilization of more effective scientific methodologies for the study of such complex behaviors as reading, thinking, memory, and problem-solving.
- **Psychobiology**—Environmental, genetic, hormonal, and motivational determinants of behavior; animal learning and memory, conditioning and stimulus control, preferences and aversions, ingestive and reproductive behavior, migration and homing, social and communicative behavior.
- **Social and Developmental Psychology**—Laboratory and field studies of the effects on individual behavior of the actual or implied presence of other persons, as well as changes in personality, social behavior, and emotional responsiveness that occur throughout the life span.

Social Sciences

- **Economics and Geography and Regional Science**—Microfoundations of economic aggregates; effects of market structure on the stability of the economy and the distribution of its proceeds; the interaction of fiscal and monetary variables, particularly as these pertain to problems of inflation and unemployment; consequences of resource depletion for economic growth; scope and implications of nonmarket decisionmaking; location and diffusion theory; residential choice; industrial location decisionmaking; regional economic development; population and settlement geography; the role of environmental perception in location and transportation decisions; the impact of human settlement and activity on the environment.
- **Sociology**—Societal and urban development; the growth of complex organizations, collective decisionmaking, social movements, the changing differentiation of roles and statuses in human groups, interaction networks, and how these influence and are influenced by group performance, resource allocation, and the distribution of rewards; size, composition, and distribution of the population and how such demographic variables affect and are affected by features of social organization; variables in residential integration; impact of organizational networks on community decisions; models to explain social change.
- **Political Science, Law and Social Science**—Explanations of regularities in the distribution of political activity; impact of broad societal changes (such as labor force composition and changes in intergroup relations) on patterns of political participation; models of political decisionmaking; sources and implications of political disaffection; policymaking processes in complex bureaucracies; impact of governmental decisions made at one level on the problems and functioning at other levels of government; capacity and limitations of the law in affecting the behavior of individuals and organizations; conditions that enhance or diminish the impact of law and the processes by which this impact is achieved or undermined; personal, cultural, and social factors that affect the use of law in dispute settlement; the operation of informal systems for processing legally relevant disputes; causes and processes of change in legal systems.

Research on criminal law is supported only

under special circumstances; the primary Federal responsibility for research on criminal law has been assigned to the National Institute of Law Enforcement and Criminal Justice.

- **History and Philosophy of Science**—The nature and processes of development in science and technology through studies that illuminate the interplay between science and technology, the impact of science and technology on society, the interaction of social and intellectual forces that promote or retard the advance of science, and the differences in the nature of theory and evidence in different scientific fields. (The history of medicine is *not* supported.)
- **Special Projects and Social Indicators**—Special projects to improve the quality of social science data and increase their potential for research. Includes improvements in survey research operations, social indicator development, data accessibility, and selected projects to expand the general social science data base.

Doctoral Dissertation Research

The National Science Foundation awards grants to improve the scientific quality of dissertations in the social sciences, behavioral sciences, and in certain biological sciences, earth sciences, atmospheric sciences, and oceanography. They are intended to make possible the acquisition of data and the means for its analysis that otherwise would not be available. Scientific content, importance, and originality, together with evidence that a grant will significantly increase the potential scientific contribution of the research, are the principal considerations in making awards.

Grants are awarded for periods up to 24 months. Grant funds may not be used as a stipend for the doctoral candidate, who may, however, receive such support from other sources.

Eligibility

Proposals may be submitted by universities on behalf of doctoral candidates for the support of dissertation research in systematic biology, ecology, and population biology; in the social sciences, including science policy; neurosciences, psychological sciences, anthropology, and linguistics; and in atmospheric sciences, earth sciences, and ocean sciences.

Proposals should be submitted by the dissertation advisor, department chairman, or chairman of the departmental committee on doctoral degrees.

Deadlines

Proposals may be submitted at any time. A minimum of 4 months is required for processing an application.

Additional Information

Leaflets providing more specific information and setting forth application procedures are available from the Foundation. Communications may be addressed to the following Divisions: Atmospheric Sciences; Earth Sciences; Ocean Sciences; Behavioral and Neural Sciences; and Social Sciences.

Industry/University Cooperative Research

There has been a growing concern voiced by the Congress, the National Science Board, and the scientific and technological community about the need for more effective communication and cooperation between scientists in colleges and universities and scientists in industry. The universities produce knowledge and trained manpower, and the industrial sector translates knowledge into socially and economically useful developments. The ties between these two segments of the Nation's scientific and technological resources need to be strengthened.

This program supports and encourages cooperative research between universities and industrial firms. Proposals must be prepared jointly by academic and industrial researchers and must be submitted jointly by their respective institutions. The research should focus on fundamental scientific questions rather than on technological development. The Foundation will make awards to either academic or industrial organizations, depending on which is the more appropriate for a particular cooperative research effort.

Proposals should be submitted to NSF in accordance with instructions contained in the NSF publication, *Grants for Scientific Research* (NSF 78-41). Proposals should be identified on the cover page as candidates for the industry/university cooperative competition.

Eligibility

Universities and colleges and established profitmaking industrial firms, including small business (or groups of such firms), are eligible for the competition. A major consideration will be the extent to which the cooperating entities represent bona fide independent operations as evidenced by the absence of interlocking relationships. A further consideration will be the extent to which the proposed research may be expected to make a long-term contribution toward product and/or process innovation. Proposals will be judged first on scientific excellence, using NSF criteria and established peer review procedures. The potential of the research to enhance cooperation between academic and industrial organizations will be a factor in the award decision. In general, active participation by both academic and industrial researchers will be required. Some cost-sharing by academic and industrial organizations participating in the program is desirable. Cost-sharing may involve funds, laboratory space, and/or personnel services.

Additional Information

Inquiries concerning support for cooperative research efforts may be directed to the following NSF directorates and officers as most appropriate:

Deputy Assistant Director
Mathematical and Physical Sciences
and Engineering (202/632-4240)

Deputy Assistant Director
Biological, Behavioral, and
Social Sciences (202/634-1553)

Director of Operations
Applied Science and Research
Applications (202/632-7426)

Deputy Assistant Director
Astronomical, Atmospheric, Earth,
and Ocean Sciences (202/632-4166)

Research Initiation in Minority Institutions

The Research Initiation in Minority Institutions program supports initiation of research by faculty members of those institutions of higher education whose enrollments are predominantly composed of Black, Native American, Spanish Speaking, or other ethnic minorities.

The scientific merit of proposals submitted to the program is established according to procedures within the various Research Directorates of the Foundation. The criteria to be applied are discussed in the brochure *Grants for Scientific Research* (NSF 78-41).

Research initiation projects will be supported for a maximum period of 36 months. Funds provided may be used to defray the NSF share of the categories of expenses described in *Grants for Scientific Research*. Research initiation grants are nonrenewable. Proposals requesting continued support may be submitted but are not eligible for this program.

Eligibility

Institutions eligible to submit proposals are those institutions of higher education whose enrollments are predominantly (more than 50 percent) composed of Black, Native American, Spanish Speaking, or other ethnic minorities. An institution's eligibility for the program will be on the basis of ethnic enrollment data furnished by the institution to the Office for Civil Rights, Department of Health, Education, and Welfare. Proposals may involve collaboration in which some of the research is carried out at institutions that do not meet these criteria. Proposals may be submitted on behalf of each principal investigator who is a faculty member of an eligible institution and who is not presently receiving and has not received Federal research support as a faculty member at the institution.

Proposals are to be prepared in accordance with instructions in the brochure *Grants for Scientific Research and the brochure Research Initiation in Minority Institutions*, available from:

Publications Unit
Mail, Security, and Records
Section
National Science Foundation
Washington, D.C. 20550

Principal investigators should consult the *NSF Bulletin* for information on research program deadlines and target dates. Information on obtaining the *NSF Bulletin* can be found on the inside front cover of this *Guide to Programs*.

Additional Information

Inquiries regarding research initiation in minority institutions should be addressed to the NSF organizational unit that has responsibility for supporting research in the proposer's field of interest.

II. Astronomical, Atmospheric, Earth, and Ocean Sciences

Basic research in the astronomical, atmospheric, earth, and ocean sciences is supported to increase knowledge of the environment, both on Earth and in space. General objectives of these activities are:

- New knowledge in astronomy and the atmospheric sciences over the entire spectrum of physical phenomena. New knowledge in astronomy about all the objects in the universe, from interstellar matter to clusters of galaxies; in particular, how they are formed and evolved.

- A better understanding of the physical and chemical makeup of the Earth and its geological history.

- Further insights into the oceans' composition, structure, behavior, and resources, and the effect of human activities on the ocean environment and vice versa.

- Advanced knowledge of natural phenomena and processes in the arctic and antarctic regions.

Astronomical Sciences

The overall objective of the Astronomical Sciences program is to increase man's knowledge of the universe. Research is aimed at examining the physical principles governing the universe, the structures of the planets and their atmospheres, the solar system, the Milky Way, and remote galaxies.

The National Science Foundation provides support for the development and operation of five National Astronomy Observatories where radio, optical, infrared, and special telescopes are made available on a competitive basis to the scientific community. Resident staffs at the centers provide technical assistance to visiting scientists, conduct studies of their own, and develop advanced instrumentation. These centers meet national needs for research in specific areas of science requiring facilities, equipment, staffing, and operational support that could not appropriately be provided to a single institution to the exclusion of others. Unlike many federally sponsored research laboratories, the NSF-supported National Astronomy Observatories do not perform specific research tasks assigned by or for the direct benefit of the Government. They are maintained for the purpose of making available, to all qualified scientists, the facilities, equipment, skilled personnel support, and other resources required for the performance of independent research of the scientist's own choosing.

Astronomy Project Support

The Astronomy Project Support program provides a broad base of support for fundamental research directed at understanding the states of matter and physical processes in the solar system, our Milky Way galaxy, and the larger universe.

Deadlines

Proposals may be submitted at any time during the year. Approximately 7 months should be allowed for reviewing and processing of a formal proposal.

Additional Information

The research areas of NSF programs in Astronomy Project Support are summarized as follows:

- **Solar System Astronomy**—The detailed structure and activity of the Sun; planetary surfaces, interiors, atmospheres, and satellites; the nature of small bodies—the asteroids, comets, and meteors—and their relevance to the origin and development of the solar system; the 1980-81 increase to maximum of the quasi-periodic surface activity of the Sun.
- **Stars and Stellar Evolution**—All aspects of the stellar life cycle, including observational and theoretical studies of the beginning and end points of stellar evolution; physical properties of various classes of stellar objects, including the effects of mass loss, rotation, and magnetic fields on stellar structure; theoretical and laboratory studies associated with atoms and molecules in space.
- **Stellar Systems and Motions**—Studies of stars in the immediate vicinity of the sun through determining their distances and motions with the highest attainable precision; improved coverage of the southern skies; binary and multiple star systems; application of the recently developed optical and radio techniques.
- **Galactic and Extragalactic Astronomy**—Theoretical and observational studies of the interstellar medium (including interstellar molecules), the Milky Way galaxy, and distant galaxies and quasars. Studies include infrared studies of extragalactic objects, use of millimeter wavelengths to map molecular clouds, the chemistry of interstellar space, and observational cosmology.
- **Astronomical Instrumentation and Development**—Development and construction of state-of-the-art detectors and data handling equipment; procurement of detector and analysis systems for telescopes at university facilities that presently lack such systems; development of interactive picture processing systems; very long baseline interferometric instrumentation; application of new technology and innovative techniques to astronomy.
- **Radio Spectrum Management**—Preparation and participation in the 1979 World Administrative Radio Conference; coordination with Government agencies of radio spectrum usage for research and frequency assignments for other telecommunications/electronics systems.

National Astronomy and Ionosphere Center

NSF supports the National Astronomy and Ionosphere Center (NAIC), a visitor-oriented National Research Center devoted to scientific investigations in aeronomy and radio and radar astronomy. NAIC is operated and managed under contract to NSF by Cornell University. The headquarters of NAIC are located in Ithaca, N.Y. The principal NAIC observing facilities are located in Puerto Rico, 19 kilometers (12 miles) south of the city of Arecibo.

NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters, movable line feeds, and digital data acquisition and processing equipment. NAIC has a permanent staff of scientists, engineers, and technicians who are available to assist visiting investigators with their observing programs.

The principal research instrument is a 305-meter (1,000-foot) fixed spherical radio/radar telescope, the world's largest single radio reflector. The frequency capabilities range from 300 megahertz to 5 gigahertz. Transmitters include an S-band (2,380-megahertz) radar for planetary studies and a 430-megahertz radar system for aeronomy studies. A second observing site, located 9.6 kilometers (6 miles) from the main site, has a 30.5-meter (100-foot) steerable parabolic antenna. This antenna is presently paired with the main antenna to provide an effective interferometric S-band radar mapping system. This antenna pair will be available for radio astronomy interferometry this year at a wavelength of 12 centimeters.

An upgraded receiver in the 430-megahertz radar backscatter system has greatly increased the sensitivity of the Arecibo telescope for aeronomy research. A high-power HF transmitter facility for ionospheric modification is presently under construction and will provide a unique opportunity to investigate nonlinear plasma dynamics. The new Harris computer system and the array processor have greatly enhanced data processing capabilities at the observatory.

Eligibility

The NAIC facilities and instrumentation are available on a competitive basis to qualified scientists from all over the world. Availability is given on the basis of scientific merit of the proposed research, the capability of the instruments to carry out the proposed observations, and the availability of telescope time.

Additional Information

Communications should be addressed to: Director, National Astronomy and Ionosphere Center, Cornell University, Ithaca, N.Y. 14853.

Kitt Peak National Observatory

NSF supports the Kitt Peak National Observatory (KPNO) in order to make available to qualified scientists the optical telescopes required for advanced research in galactic, extragalactic, and solar astronomy.

The headquarters of KPNO are in Tucson, Ariz. Observing facilities are located on Kitt Peak, a 2,089-meter (6,875-foot) mountain 90 kilometers (56 miles) southwest of Tucson. KPNO is supported under the terms of a contract between NSF and the Association of Universities for Research in Astronomy, Inc. (AURA). AURA is responsible for the operation and management of KPNO.

KPNO provides the U.S. scientific community with the world's largest concentration of modern optical telescopes and auxiliary instrumentation. The facilities consist of telescopes and auxiliary equipment necessary to observe astronomical objects in the optical and infrared regions of the electromagnetic spectrum.

The observatory is the site of the second largest reflector in the United States, the 4-meter Mayall Telescope, and also the site for the largest solar research instrument, the 1.5-meter McMath Solar Telescope.

Eleven other KPNO telescopes atop Kitt Peak include a 2.1-meter general purpose reflector with optimized infrared observing equipment, a 92-centimeter coude feed (associated with the 2.1-meter), a 1.3-meter Cassegrain reflector for infrared observations and photometric studies, and two 91-centimeter auxiliary telescopes available for solar, planetary, and bright object observations. A solar vacuum telescope and magnetograph is used for synoptic observations of the Sun. Solid state array detectors, particularly of the charge injection device type, are being applied to several faint-object observational problems. Seven different infrared instruments are now in use on the 1.3-meter, 2.1-meter, and 4-meter telescopes, all of which are equipped with the chopping secondary mirror required for infrared work. Kitt Peak also operates the Harrison "C" ruling engine, currently the only source of large, high efficiency diffraction gratings for the astronomical community.

Kitt Peak is also the site of three University of Arizona telescopes, a University of Michigan 1.3-meter telescope, and a radio telescope operated by the National Radio Astronomy Observatory.

KPNO is a visitor-oriented facility that assigns visiting astronomers 60 percent of the observing time on the telescopes; it has a staff of resident scientists, engineers, and technicians who are available to assist them.

Eligibility

KPNO makes observing time on each instrument available for the use of visiting scientists. All qualified U.S. scientists and, on occasion, foreign visitors may use the instruments, subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work, and available instrument time.

Additional Information

Communications should be addressed to: Director, Kitt Peak National Observatory, P.O. Box 26732, Tucson, Ariz. 85726.

Cerro Tololo Inter-American Observatory

NSF supports the Cerro Tololo Inter-American Observatory (CTIO), an astronomical research center with optical telescopes and related facilities, to provide qualified scientists with the opportunity to observe those parts of the Southern Hemisphere skies not visible or not adequately observable from the United States.

The observing facilities of CTIO are located on a 2,194-meter (7,200-foot) mountain in the foothills of the Chilean Andes about 482 kilometers (300 miles) north of Santiago. The administrative headquarters are in the coastal city of La Serena, about 64 kilometers (40 miles) from the observatory. CTIO is supported under the terms of a contract between NSF and the Association of Universities for Research in Astronomy, Inc. (AURA). AURA is responsible for the operation and management of CTIO.

CTIO has eight telescopes. The newest of these is the 4-meter (158-inch) near-twin to the Kitt Peak 4-meter telescope. The others are the 1.5-meter (60-inch), 91-centimeter (36-inch), 61 centimeter (24-inch), and two 41-centimeter (16-inch) reflectors; a 61/91-centimeter (24/36-inch) Schmidt telescope on loan from the University of Michigan; and a 1-meter (40-inch) reflector on loan from Yale University. The 61-centimeter telescope was originally installed by the Lowell Observatory for planetary observations. These instruments are equipped with spectrographs, cameras, and photometers that are similar to the ones at Kitt Peak.

CTIO has a small permanent staff of scientists, engineers, and technicians who are available to assist visiting scientists and observers.

Eligibility

Most of the observing time at Cerro Tololo is used by visiting astronomers. Qualified scientists may use the instruments subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the available instrument time.

Additional Information

Communications should be addressed to either: CTIO Liaison Officer, Kitt Peak National Observatory, P.O. Box 26732, Tucson, Ariz. 85726, or, Director, Cerro Tololo Inter-American Observatory, Casilla 63-D, La Serena, Chile, South America.

National Radio Astronomy Observatory

NSF supports the National Radio Astronomy Observatory (NRAO), which makes radio astronomy facilities available to qualified scientists. The NRAO staff assists visiting scientists with the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects.

Headquarters for NRAO are in Charlottesville, Va.; the three observing facilities are located in Green Bank, W. Va., Kitt Peak near Tucson, Ariz., and 80 kilometers (50 miles) west of Socorro, N. Mex. NRAO is supported under the terms of a contract between NSF and Associated Universities, Inc. (AUI), a nonprofit corporation. AUI is responsible for the operation and management of NRAO.

Two telescope systems will be operated at the National Radio Quiet Zone site in Green Bank. The premier telescope at Green Bank will continue to be the 43-meter (140-foot) instrument with its capability to study spectral lines at centimeter wavelengths and its increasing role as part of the Very Long Baseline Interferometer network involved in studies of quasars and the high resolution mapping of galactic objects over transcontinental and intercontinental distances. The large aperture, 91-meter (300-foot) telescope is instrumented for survey studies of both continuum and spectral line radiation of galaxies where its great sensitivity is an advantage. An 11-meter (36-foot) millimeter wavelength telescope is located on Kitt Peak to take advantage of the high, dry climate necessary for short radio wavelengths. This telescope is capable of both continuum and spectral line studies at wavelengths from 1 centimeter to as short as 1 millimeter. The Very Large Array (VLA) near Socorro, N. Mex., is now in partial operation. With a full complement of nine antennas on a 10.4-kilometer (6.5-mile) southwest baseline and five antennas along the 1.5-kilometer (0.9-mile) southeast arm, the VLA provides observational detail on faint radio sources never before possible. The four-element interferometer at Green Bank will no longer be supported by NSF because of the ability of the VLA to take on its observing programs.

Eligibility

NRAO makes observing time on each instrument available for the use of visiting scientists. All qualified U.S. scientists and, on occasion, foreign visitors may use the instruments, subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the available instrument time.

Additional Information

Communications should be addressed to: Director, National Radio Astronomy Observatory, Edgemont Road, Charlottesville, Va. 22901.

Sacramento Peak Observatory

NSF supports the Sacramento Peak Observatory (SPO), a National Research Center devoted to studies in the fields of solar physics, solar-terrestrial relationships, and related disciplines. SPO makes available optical solar telescopes, observing instrumentation, and research support services to qualified scientists.

SPO is supported under the terms of a contract between NSF and the Association of Universities for Research in Astronomy, Inc. (AURA). AURA, a nonprofit consortium of 14 universities, is responsible for the administration, operation, and management of SPO.

The SPO observing facilities are located at an elevation of 2,800 meters (9,200 feet) on a crest of the Sacramento Mountains in south-central New Mexico, 59 kilometers (37 miles) by road, east of Alamogordo. SPO provides the scientific community with the world's largest collection of modern optical solar telescopes and auxiliary instrumentation designed to observe the solar photosphere, chromosphere, and corona. The principal instruments are a 109-meter high solar vacuum tower telescope with an echelle spectrograph, digital diode array, and tunable filters; and an 8-meter spar in the Big Dome complex equipped with a 40-centimeter aperture coronagraph, and a magnetograph and polarimeter. Other instrumentation includes a full complement of spectrographs, birefringent filters, and photographic, video, and digital data acquisition and processing equipment. SPO has a permanent staff of scientists, engineers, and technicians who are available to assist visiting investigators with their observing programs.

Eligibility

All qualified U.S. scientists and, on occasion, foreign visitors have access to SPO facilities on a competitive basis, subject to priorities based upon the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the time available.

Additional Information

Communications should be addressed to the Director, Sacramento Peak Observatory, Sunspot, N. Mex. 88349.

Atmospheric Sciences

The Atmospheric Sciences program supports research on a wide range of subjects to add new understanding of the behavior of the Earth's atmosphere. Included are studies of the physics, chemistry, and dynamics of the Earth's upper and lower atmosphere; the acquisition of data on physical processes in the troposphere and stratosphere that will aid in understanding the general circulation of the atmosphere and the physical basis of climate; and research on climate processes and variations, as well as research on smaller scale, shorter term phenomena, leading to greater knowledge of weather.

NSF provides support for the development and operation of the National Center for Atmospheric Research, a National Center devoted to large-scale atmospheric research projects conducted in cooperation with universities and other organizations.

NSF also provides support for the participation by the U.S. scientific community in international scientific research endeavors: the Global Atmospheric Research Program (GARP) and the International Magnetospheric Study (IMS).

Atmospheric Sciences Project Support

The objective of the Atmospheric Sciences Project Support program is to continue to build a base of fundamental knowledge of the atmospheres of the Earth and other planets, as well as of the Sun. Specific objectives include: to develop the scientific basis for understanding climate and weather; to develop the scientific basis for understanding the natural global cycles of gases and particulates in the Earth's atmosphere; to improve the ability to understand the behavior of environmental factors that control air quality in the troposphere and stratosphere; and to improve our knowledge of the Sun and of neighboring planets, especially as they relate to our understanding of the Earth's upper atmosphere.

Deadlines

Proposals may be submitted at any time during the year. Approximately 6 months should be allowed for review and processing of a formal proposal.

Additional Information

The research areas of NSF programs in Atmospheric Sciences Project Support are summarized as follows:

- **Aeronomy**—The nature and relative magnitude of high latitude energy inputs to the upper atmosphere and how dynamical and other processes couple this energy to lower latitudes; the nature of the processes that couple the upper atmosphere to the magnetosphere above it and the stratosphere below; the basic nature of the variety of plasma instabilities that can be studied in our immediate earth environment and their specific role in the magnetosphere-ionosphere-atmosphere system.
- **Atmospheric Chemistry**—The sources, sinks, and intermediate reactions that govern the global cycles and budgets of the major chemicals in the atmosphere, including their interaction with solar radiation; the nature of the time and spatial fields determining the transport of tropospheric-stratospheric constituents.
- **Meteorology**—How severe storms are initiated, organized, and maintained; the relationship of the electrical budget to the characteristics of cloud and precipitation particles; how tornadoes are initiated; the effects of haze layers and clouds on the radiation balance of the earth and atmosphere; the role of ice in the formulation of natural clouds and precipitation and how ice crystals and nuclei can be measured; the major physical processes initiating and maintaining cyclonic storms in middle latitudes and how these developments relate to severe local storms.
- **Solar Terrestrial**—How the upper atmosphere, including the magnetosphere, responds to the energy flux from the Sun; how the magnetosphere energizes particles from the Sun and the ionosphere and deposits them into the polar upper atmosphere to form the aurora; which electric currents and particles flow between the atmosphere, ionosphere, and magnetosphere; the effect of variation in the Sun's radiation on weather and climate.
- **Experimental Meteorology and Weather Modification**—Field research, involving major facilities, to investigate tropospheric weather systems from the local scale through the cyclonic scale; initiation and evolution of cloud and precipitation systems; scientific basis for modification of cloud and precipitation processes; methods for the design and evaluation of weather modification experiments; measurement and description of man's unintentional impact on weather.

Global Atmospheric Research Program

The Global Atmospheric Research Program (GARP) is a long-term commitment by many nations. Its objective is to acquire knowledge of the physical processes in the troposphere and stratosphere that are essential for an understanding of (a) the transient behavior of the atmosphere as manifested in the large-scale fluctuations that control changes of the weather, which would lead to increasing the accuracy of forecasting; and (b) the factors that determine the statistical properties of the general circulation of the atmosphere, which would lead to better understanding of the physical basis of climate.

Within the United States, by formal agreement among Federal agencies, NSF is the primary agency for the support of non-Federal research in the program, particularly at universities. The Department of Commerce is the primary agency for support of Federal activities.

Eligibility

Institutions eligible to submit proposals under GARP are academic institutions; nonacademic, nonprofit research organizations; and profitmaking and private research organizations. Occasionally, NSF sponsors supporting efforts by other Government agencies, particularly for field programs.

Deadlines

Proposals may be submitted at any time. Approximately 6 months should be allowed for review and processing of a formal proposal.

Additional Information

Communications should be addressed to: Division of Atmospheric Sciences, Climate Dynamics Research Section, National Science Foundation, Washington, D.C. 20550.

Climate Dynamics Program

Through its Climate Dynamics program, NSF supports the development of a basis for predicting climate variations and for assessing the impact of these variations on human affairs. Toward this end, the program supports research that will contribute to knowledge of the natural variability of climate and to understanding of the physical processes governing climate.

Eligibility

Proposals may be submitted by academic institutions, nonacademic and nonprofit research organizations, and profitmaking and private research organizations. Occasionally, NSF sponsors efforts by other Government agencies, particularly for field programs.

Deadlines

Proposals may be submitted at any time during the year. Approximately 6 months should be allowed for review and processing of a formal proposal. Awards will generally be made three times a year: November 1, February 1, and June 1.

Additional Information

The primary research areas of the Climate Dynamics program are:

- **Modern Climate Data Assembly and Analysis**—Documentation of the natural fluctuations of climate on a global scale over historic to modern times using ground and marine stations, satellite and upper-air soundings, ice cores, and historic data sources.
- **Paleoclimatic Data Assembly and Analysis**—Reconstruction of past climates as a means of evaluating the rate, magnitude, and frequency of climatic change. The primary sources of such data include tree rings, fossils preserved in lakes and bogs, and the deep-sea record of fossil plants and animals.
- **Climate Modeling and Simulation**—Development of a spectrum of climate models, their validation from data sets, and their use as diagnostic tools to isolate important physical mechanisms governing climate. Modeling of such mechanisms as the generation of eddies in the atmosphere and ocean, the vertical transport of heat and momentum by clouds, and feedbacks on a global scale involving clouds and radiation.
- **Climate Modification and Assessment**—Dynamical mechanisms involved in changes in climate due to human activities; simple models for determining the sensitivity of the climate to human activities; questions that deal with the agricultural, ecological, socioeconomic, and political impacts of climate and climate change.

Communications should be addressed to: Division of Atmospheric Sciences, Climate Dynamics Research Section, National Science Foundation, Washington, D.C. 20550.

National Center for Atmospheric Research

NSF supports the National Center for Atmospheric Research (NCAR), which serves as a focal point for research in the atmospheric sciences. NCAR offers support services, fellowships, and research facilities to qualified scientists working in this field.

Headquarters and major laboratories of NCAR are located in Boulder, Colo. Research activities and operations are worldwide. Support of NCAR is provided under the terms of a contract between the Foundation and the University Corporation for Atmospheric Research (UCAR), a nonprofit corporation. UCAR is responsible for the operation and management of NCAR.

Research programs of NCAR include investigation of the Earth's atmosphere, of the physics of the Sun, and of the regions between the Sun and Earth. NCAR facilities in support of NCAR and of visiting scientists include the National Scientific Balloon Facility at Palestine, Tex., a Computing Facility at Boulder, the Research Aviation Facility at Broomfield, Colo., and a Field Observing Facility at Marshall, Colo.

In addition to conducting its own research programs, NCAR participates in a number of atmospheric research efforts conducted by Government agencies, university scientists, and research groups on a national or international scale. Major efforts include development and testing of numerical models of large-scale atmospheric circulation; the interaction between the properties of clouds and the Earth's surface heat; improved forecasting of severe weather events; relationship among chemical, physical, and dynamic processes in the stratosphere and beyond, the phenomena occurring in the lower atmosphere, and phenomena due to solar variability; the cause-effect relationship among phenomena occurring on and below the solar surface, in the solar atmosphere, and in space out to the Earth's atmosphere. More than 600 scientists, engineers, technicians, and support personnel comprise the NCAR staff.

Eligibility

Visiting scientists study and conduct research at NCAR under fellowships and research programs. NCAR facilities are available to qualified scientists, subject to scheduling considerations.

Additional Information

Communications should be addressed to: Director, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colo. 80307.

Earth Sciences

The Earth Sciences programs are devoted to increasing basic knowledge of the Earth and its ocean floor. Earth Sciences supports research to obtain basic information about the nature, origin, history, and behavior of rock formations. The results of this research provide better understanding of the forces that affect the Earth's interior and modify its surface and of the processes that have produced petroleum, coal, metals, and other earth resources. NSF also sponsors the Ocean Sediment Coring program, an international scientific endeavor directed at understanding the geologic history of the Earth through examination of the ocean floor.

Earth Sciences Project Support

The Earth Sciences Project Support program is concerned primarily with the geological, geophysical, and geochemical constitution of the Earth's crust. The objective of this program is to provide a basic knowledge of the structure and composition of rocks that comprise the Earth's crust and the processes that form and modify these rocks. The results of this research will provide a sound scientific foundation for the search for natural resources and for continuing attempts to predict, prevent, or diminish the effects of such natural hazards as earthquakes, volcanic eruptions, and landslides. Improvement of techniques to detect and reduce water pollution and solid waste disposal problems also results from earth science research.

Deadlines

Proposals may be submitted at any time during the year. Approximately 6 months should be allowed for review and processing of a formal proposal.

Additional Information

The research areas of NSF programs in Earth Sciences Project Support are summarized as follows:

- **Geology**—Field and laboratory research into the nature of the earth, its physical and biologic history, and the modern processes that alter its surface; testing of the validity of plate tectonics; general structural studies of the interiors and margins of continents.
- **Geochemistry**—The composition, age, and origin of rocks and minerals and the causative processes; source and conditions of deep-seated volcanism and the processes involved in the transportation and segregation of chemical elements in the earth's crust; geochemistry of ore bodies; laboratory experiments in crystallization.
- **Geophysics**—Physical state and properties of the Earth. Subfields covered are seismology, gravity, geodesy, rock magnetism, terrestrial currents, heat flow, and high pressure phenomena.

Ocean Sediment Coring Program

NSF sponsors the acquisition of geologic samples from the floor of the deep ocean basins by means of rotary drilling and coring in the sediments and the underlying crystalline rocks. Portions of the core samples are made available to qualified scientists for individual research projects.

The major activity under the program is known as the Deep Sea Drilling Project, managed by Scripps Institution of Oceanography of the University of California, San Diego. The drilling and coring operations are performed aboard the ship *Glomar Challenger*. About 60 deep ocean sites are occupied per year, yielding about 20,000 linear feet of 2½-inch-diameter cores. Drill sites have been located in water depths exceeding 20,000 feet, and sub-bottom penetrations of more than 5,700 feet have been achieved. Since August 1968, about 750 holes have been drilled and cored at about 475 sites in the Atlantic, Pacific, Antarctic, and Indian Oceans; the Mediterranean, Caribbean, Bering, Norwegian, and Red Seas; and the Gulf of Mexico.

About 14 to 16 scientists participate aboard the drilling ship on each 2-month cruise, describing the cores lithologically and paleontologically. These descriptions and resulting interpretations, along with those from shore-based laboratories, are published in a series of volumes—*Initial Reports of the Deep Sea Drilling Project*, one volume for each cruise. The volumes are placed with all major libraries, and are available for purchase by individuals from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Samples of core material for detailed analysis are available to qualified scientists throughout the world a year after the completion of the cruise that collected the cores.

Additional Information

Communications should be addressed to: Division of Earth Sciences, National Science Foundation, Washington, D.C. 20550.

Suggestions for scientific planning, including sites to be included on the drilling itinerary, should be addressed to: Manager, Deep Sea Drilling Project, Scripps Institution of Oceanography, University of California, San Diego, Calif. 92037.

Scientists interested in participating aboard the drilling ship should write to: Chief Scientist, Deep Sea Drilling Project, address as above.

Requests for samples of the core material should be directed to: Curator, Deep Sea Drilling Project, address as above.

Proposals for studies of core materials should be submitted to: Central Processing Section, National Science Foundation, Washington, D.C. 20550.

Ocean Sciences

The overall objective of the Ocean Sciences program is to improve understanding of the nature of the ocean, its influence on human activities, and human impact on the marine environment. This is accomplished through two basic research programs—one for support of individual scientists, primarily at the oceanographic institutions, the other for support of a limited number of large projects within the International Decade of Ocean Exploration (IDOE)—plus a program that provides acquisition and operating costs for the oceanographic facilities needed to carry out these research programs—the Oceanographic Facilities and Support (OFS) program.

Oceanography Project Support

The Oceanography Project Support program funds a broad range of research projects dealing with the physical, chemical, geological, and biological processes in the ocean. Large and small grants of several months' to several years' duration are awarded to highly qualified research scientists. Grants are made on the basis of a competitive peer review of unsolicited research proposals.

The research areas of NSF programs in Oceanography Project Support are summarized as follows:

- **Physical Oceanography**—Modeling of ocean circulation on a worldwide scale; eddy processes on the mesoscale and their effects on global energy and momentum transport; boundary current interactions with the global and mesoscale processes; physical processes of circulation, eddy generation, and turbulent mixing on the continental shelves; mixing processes and circulation in rivers and bays where fresh water and the ocean meet; boundary current interactions with continental shelf waters; wind-generated waves and tides; transport processes on very small scales—generally less than a meter; three-dimensional turbulence; physical properties of seawater; physical processes of circulation and mixing in lakes.
- **Marine Chemistry**—Equilibria of chemical species and compounds in seawater and their availability for reacting with other chemical phases in the marine environment; fluxes between the surface sediments of the sea floor and the interstitial waters and the fate of material deposited on the ocean floor; alterations of material moving through the water column; marine organic chemistry and biochemistry; air-sea exchange phenomena related to the sea as a source or sink for manmade and naturally mobilized chemicals; kinetic and thermodynamic reactions in the marine environment; physical and chemical properties of seawater.
- **Submarine Geology and Geophysics**—Studies of continental margins, oceanic rise systems, and deep-sea sedimentary basins; the exchange of heat and chemical elements between seawater and oceanic rocks, the tectonic and volcanic activity at mid-ocean ridges, and the chemical and mineralogic variations in marine sediments; physical processes of sediment deposition and erosion; past oceanic circulation patterns, paleoclimates, evolution of microfossil groups, effects of water chemistry and temperature controls on fossil assemblages and sediment types, and the interaction of land and oceanic geologic processes.
- **Biological Oceanography**—Distribution, abundance, physiology, and life history of pelagic marine organisms, their interactions with the chemical and physical environment, and their relationships with other organisms of the open sea, with emphasis on identifying the causal mechanisms regulating the distribution and abundance of pelagic organisms; coastal marine organisms and their interactions with the physical and biological aspects of the benthic sea bottom environment, with emphasis on the structure of detritus-based food chains and on manipulative, experimental studies analyzing the factors that regulate the development of benthic communities; ecological investigations of the deep-sea biota, with emphasis on interactions of sea floor biological processes with the overall ocean ecosystem and biological specializations of the organisms of this environment; ecological investigations of organisms and communities of the Great Lakes, with emphasis on factors regulating phytoplankton populations.

Deadlines

Proposals may be submitted at any time. Approximately 6 months are required for review and processing of a formal proposal. The annual schedule of proposal review panel meetings with the associated proposal submission deadlines and earliest possible starting dates is as follows:

Proposal Deadline	Panel Meeting	Start Date (earliest)
30 Apr.	July	1 Oct.
15 Aug.	Oct.	1 Jan.
31 Dec.	Mar.	1 June

Additional Information

Communications should be addressed to: Division of Ocean Sciences, Oceanography Section, National Science Foundation, Washington, D.C. 20550.

International Decade of Ocean Exploration

In support of the International Decade of Ocean Exploration (IDOE), NSF awards grants and contracts for cooperative programs of ocean research and exploration with emphasis on environmental quality, environmental forecasting, seabed assessment, and living resources. The program supports a relatively small number of research projects which concentrate on broad scientific problems especially susceptible to concerted effort by the research community. The Decade is unique in that it brings major efforts to bear on globally planned and coordinated studies of the ocean as a system. The long-range goals of the Decade are:

- Preserve the ocean environment by accelerating scientific observation of the natural state of the ocean and its interactions with the continental margins.
- Develop and improve an ocean forecasting and monitoring system to facilitate prediction of oceanographic and atmospheric conditions, and to reduce hazards to life and property and permit more effective use of marine resources.
- Expand seabed assessment activities to permit better management of ocean mineral exploration and exploitation.
- Improve worldwide oceanographic data exchange.
- Increase opportunities for international sharing of responsibilities and costs for ocean exploration and assure better use of limited exploration resources.

The U.S. national program and other nation's IDOE programs are coordinated closely with the Long-Term and Expanded Program of Oceanic Exploration and Research (LEPOR) of UNESCO's Intergovernmental Oceanographic Commission. IDOE is identified as "the acceleration phase" of this program.

Eligibility

Industry and other organizations are eligible for support on the same basis as educational institutions in the Foundation's International Decade of Ocean Exploration program. Universities will receive support in the areas of research suited to their expertise. Unsolicited research proposals are subject to cost-sharing. Proposals are solicited as necessary in certain areas. Awards resulting from solicited proposals may provide full costs, with cost-sharing or fees negotiated as appropriate.

Guidelines on eligibility, programs, and proposal preparation are contained in the NSF publication *International Decade of Ocean Exploration—A Guide to the Preparation of Proposals*, which may be obtained from the Foundation.

Deadlines

Proposals may be submitted at any time. Approximately 6 months are required for review and processing of a formal proposal.

Additional Information

Communications should be addressed to: Division of Ocean Sciences, Office for the International Decade of Ocean Exploration, National Science Foundation, Washington, D.C. 20550.

Oceanographic Facilities and Support

The National Science Foundation makes awards for support of construction, modification, conversion, purchase, and operation of oceanographic facilities which lend themselves to shared usage. Community arrangements for shared use of these facilities have been developed under the University National Oceanographic Laboratory System (UNOLS).

Facilities supported under this program are those required for research both in the open oceans and in coastal areas. Examples of such facilities are ships, boats, submersibles, aircraft, piers, shipboard and related shore computing capability, and environmental simulation units.

The Foundation encourages local contributions from non-Federal funds whenever possible;

however, there is no fixed requirement as to the amount of funds that institutions must contribute.

Before submitting a proposal for support under this program, the institution should seek advice from the Office for Oceanographic Facilities and Support (OFS). A general brochure and specific formats and instructions are available for certain program activities, such as ship operations support, shipboard technician support, and support of capital equipment.

Eligibility

The primary objective of OFS is to provide support for large and expensive oceanographic facilities in accordance with the demonstrated needs of NSF-funded research and training programs in the total academic oceanographic community. Access to NSF-funded facilities is assured to qualified users through UNOLS.

OFS support for major oceanographic facilities utilized by the academic community is concentrated at a limited number of institutions which are suitably located and have the logistic capability to carry out major facility operations. These facility-operator institutions have substantial ongoing oceanographic research programs of their own and also provide facilities support for research programs of nonoperator institutions. Nonoperator academic institutions with substantial oceanographic research programs may apply for direct facilities support if they can demonstrate the capability to conduct such operations to fulfill research requirements not now being met.

Deadlines

Ship operations, shipboard technician, and shipboard equipment proposals are due July 1 each year. Proposals requesting support for other activities may be submitted at any time during the year.

Additional Information

Communications should be addressed to: Division of Ocean Sciences, Office for Oceanographic Facilities and Support, National Science Foundation, Washington, D.C. 20550.

Polar Programs

U.S. Antarctic Research

The National Science Foundation awards grants or contracts for research in and around Antarctica and for antarctic research at home institutions.

The goal of the U.S. Antarctic Research program is to maintain the Antarctic Treaty to ensure that the continent will be used for peaceful purposes, to foster research that contributes to the solution of regional and worldwide problems, to protect the environment, and to ensure equitable and wise use of resources. Research is supported in the disciplines of biology and medicine, upper atmosphere physics, geology and geophysics, meteorology, oceanography, and glaciology. Some objectives of the program are to understand the function, evolution, and adaptations of land and sea species and ecosystems; to understand the geology and the geologic history of the continent and its surrounding ocean basins; to study the structure and the dynamics of the magnetosphere and the ionosphere, which are uniquely measurable at the high geomagnetic latitudes of Antarctica; to determine Antarctica's role in past and present global climate through study of surface and upper air processes, through study of the structure, dynamics, and chemistry of the ice sheet, and through study of oceanic circulation; and to investigate the physical and chemical oceanography of antarctic seas.

Research may be performed at the four year-round U.S. research stations: Palmer (65°S. 64°W.), Siple (76°S. 84°W.), Amundsen-Scott South Pole (90°S.), and McMurdo (78°S. 167°E.). Each station has laboratories or specialized research equipment and is adequate for comfortable year-round residence. Research may also be performed aboard the ice-strengthened research ships *Hero* and *Islas Orcadas* and aboard Coast Guard icebreakers, aboard a research-configured

LC-130 airplane, at camps during the austral summer at almost any continental location and, occasionally, at stations of other Antarctic Treaty nations.

From early October to late February, frequent air service is provided between the United States and all stations except Palmer, which is serviced by *Hero* and other ships between December and April. Also, flights generally are made to McMurdo in early September. For the rest of the year the stations operate in isolation. In the austral winter, *Hero* makes research cruises off southern South America.

A brochure, updated yearly, further describes the program, sets forth research opportunities and objectives, describes facilities, logistics, and other support available to investigators, and explains how to prepare proposals. An investigator should get a copy of this brochure from the Division of Polar Programs before preparing a proposal.

Eligibility

Academic institutions and academically related nonprofit research organizations may submit proposals for grants or contracts for research project support. Industry and other local, State, and Federal agencies also are eligible for support.

Deadlines

Requests for support of research must be received by June 1 of the year preceding the proposed commencement of field work. For example, proposals for the 1980-81 austral summer and the 1981 austral winter should be received by June 1, 1979. Scientists must specify their logistic needs in their proposals. Forms and information are available from the Division of Polar Programs.

Additional Information

Investigators will be aided in preparation of proposals through use of the brochure referred to above, use of the Foundation's booklet *Grants for Scientific Research*, and preliminary communication with the Science section and, for field work, the Operations section of the Division of Polar Programs.

Literature published between 1951 and the present is cited in the multivolume *Antarctic Bibliography*, available from the U.S. Government Printing Office, Washington, D.C. 20402. The monthly *Current Antarctic Literature* is available through the Division of Polar Programs. Literature published before 1951 is listed in *Antarctic Bibliography* (1968, Greenwood Press).

Knowledge of Antarctica is summarized in the *Antarctic Map Folio Series* (American Geographical Society, New York). Maps of the continent are available from the National Geographic Society (Washington, D.C.) and the American Geographical Society (New York). Small-scale maps are available from the U.S. Geological Survey, 1200 S. Eads Street, Arlington, Va. 22202.

Ice cores, ocean bottom sedimentary cores, terrestrial sedimentary cores, dredged rocks, biological specimens, and ocean bottom photographs are available for study. Request "specimen and core-sample distribution policy."

Address communications to Division of Polar Programs, National Science Foundation, Washington, D.C. 20550.

Arctic Research

Within the Arctic Research program, the Foundation supports both individual research and large multidisciplinary projects. The program has rather specific objectives, which are described both below and, at greater length, in an annually revised brochure available from the Division of Polar Programs.

The Arctic Research program comprises only about half of the arctic-related research supported by the National Science Foundation. Investigators planning to propose research within a given discipline should examine other NSF programs to determine which program has research objectives most closely related to the research project that is to be proposed. Further, a number of other Federal agencies support arctic research related to their particular missions.

The goal of this program is to intensify arctic research both to enable fuller utilization of the rapidly developing arctic region and to ensure that such activities do not inadvertently degrade the arctic environment. Research is supported in the disciplines of geology and geophysics, biology, oceanography, meteorology, glaciology, and upper atmospheric physics. Some objectives of the Arctic Research program are to define the geologic history of the Arctic Basin and the continental shelves; to determine the origin, state, and dynamics of subsea permafrost; to study living resources and the ecosystem of the Bering Sea and other marine areas; to understand the factors that influence terrestrial ecosystems; to increase knowledge of water masses, ocean floor characteristics, and the role of the Arctic Ocean in global climate; to improve understanding of air-ice-sea interaction; to study the dynamics of the Greenland ice sheet and to extract its paleoclimatic record through study of ice cores; and to improve understanding of solar-terrestrial relationships through measurement of processes in the magnetosphere, the ionosphere, and the interplanetary medium.

The Foundation generally does not provide logistics or operational support for arctic research, and it usually is the responsibility of the proposers to arrange and to budget for these items. However, for research in Greenland the Foundation sometimes arranges for aircraft support and housing at research sites.

Eligibility

Academic institutions and academically related nonprofit research organizations may submit proposals for grants or contracts for research project support. Industry and State and local government agencies also are eligible for support.

Deadlines

Requests for support of research should be received by September 1 for support in the following fiscal year, which lasts from October 1 to September 30. In all proposals, scientists must specify their logistics and operational needs and state how they are to be provided.

Additional Information

Investigators will be aided in preparation of proposals through use of the brochure referred to above, use of the Foundation's booklet *Grants for Scientific Research*, and preliminary communication with the Science section and, for field work, the Operations section of the Division of Polar Programs.

Greenland ice cores are available for study. Contact the Department of Geology, State University of New York at Buffalo, Amherst, N.Y. 14226.

A 1:5,000,000-scale map of the Arctic, published in 1975, is available from the American Geographical Society, New York.

An *Arctic Research Logistics Support Handbook*, published in 1972, is available from the Division of Polar Programs.

The *Arctic Bibliography* (16 volumes, 1953-1975, Arctic Institute of North America, Calgary) abstracts and indexes 108,000 titles relevant to the Arctic.

Address communications to Division of Polar Programs, National Science Foundation, Washington, D.C. 20550.

III. Science Education

The fundamental goal of the Science Education programs of the National Science Foundation is expressed in the Congressional mandate to: "Initiate and support . . . programs to strengthen . . . science education programs at all levels . . . . " Within that broad goal, the Science Education Directorate has assumed four major responsibilities.

First, to assure that the Nation's science education establishment can successfully meet the changing scientific needs of a dynamic society, the Foundation provides support to educational institutions to improve their capabilities to teach science and engineering and to facilitate needed innovations in science education. Second, to ensure an adequate supply of high quality science personnel to meet future demands, the Foundation provides support, through a competitive process, to highly qualified individuals who wish to pursue careers in either the theoretical or applied sciences. Third, programs of research and development are supported in order to develop the new knowledge which will allow the science education activities of the Nation to improve. Finally, programs are supported which seek to reach beyond formal educational institutions and make available to the general population information about science and the scientific process.

Each of the four major responsibilities is assigned to an operating unit of the Directorate, which administers a group of related programs.

Division of Science Education Resources Improvement (SERI)—This Division provides support to strengthen the capabilities of schools, colleges, and universities for science education and research training, ranging from programs aimed at institution-wide improvement in the sciences to highly focused projects dealing with a single component of an individual course.

Division of Scientific Personnel Improvement (SPI)—This Division provides support for fellowships, traineeships, science teacher development, and student-oriented activities, including programs to increase the entry into the sciences of the physically handicapped, women, and minorities. Programs that emphasize the development of individuals rather than institutions are the primary responsibility of this Division.

Division of Science Education Development and Research (SEDR)—In contrast to the programs of SPI and SERI, which concentrate on support of individuals and institutions using known mechanisms, the emphasis in SEDR is on activities to develop new knowledge and new means for improving science education at all levels. Programs supported range from basic research in selected areas of science education to the development of specific instructional materials, technologies, and methods. Innovation, transferability, and potential for national impact characterize projects supported by SEDR.

Office of Science and Society (OSS)—The Office of Science and Society supports projects to increase public understanding of science and technology and the role these play in meeting national needs, to increase understanding of the relations between the ethical and human values of society and scientific activities, and to improve the availability of scientific knowledge to the public.

The Science Education Directorate will give special emphasis to three important concerns: science for the early adolescent, increased participation of minorities, and increased participation of women in science education and careers. These efforts are implemented not as separate funding activities but through many of the programs described in this document.

- **Science for the Early Adolescent**—This special emphasis grows out of the Foundation's concern for the improvement of science and mathematics offerings at the junior high or middle school level and its implications for encouraging early adolescents, particularly minorities and girls, to continue in the study of science and mathematics beyond that point in their education where the majority of students choose not to continue study of these areas. Of particular interest are projects to improve science education for the early adolescent in program areas such as Pre-College Teacher Development and Information Dissemination for Science Education, the pre-service teacher training aspects of Comprehensive Assistance to Undergraduate Science Education and Local Course Improvement, and research and development activities focused on this age group in the Research in Science Education and Development in Science Education programs, among others. Additional activities may be announced during the coming year.

- **Activities for Minorities**—The Science Education Directorate has also taken positive action to increase the participation of minorities in science education and careers. Currently, this action takes two forms. First, a number of programs are aimed exclusively at underrepresented groups. These are the Minority Institutions Science Improvement program, the Resource Centers for Science and Engineering, the Minority Graduate Fellowships, the Minority Institutions Graduate Traineeships, and the Minorities in Science program, all of which are described in this document. In addition, appropriate proposals focused on increasing the science literacy and the representation of minorities in science careers are encouraged in all programs described in this document.
- **Activities for Women**—A further significant thrust is special emphasis on the concerns of women in science and engineering. The focal point of this effort is the Women in Science program described in this document. In addition, proposers of projects focused on increasing the science literacy and the representation of women in science careers are encouraged to participate in all programs described in this document.

In designing programs and selecting particular projects for support in the Science Education Directorate, a number of general criteria are used. Among these are:

- **Significance and Need.** This criterion is met if it is determined that a need has been identified which is of significance to science education.
- **NSF Role.** This criterion is met if it is determined that the need is one which should be met by the public sector, that there is a comparative advantage in meeting this need at the Federal level, and that NSF is the appropriate Federal agency to undertake the effort.
- **Feasibility and Readiness.** This criterion requires that the need to be met by a program or individual project be one which can be successfully addressed with available resources. The technology or knowledge required to meet the need must be available or able to be developed, and financial and personnel resources must also be available.
- **Cost-effectiveness.** This criterion is met if it appears that the prospective benefits of meeting an identified need are significant in comparison with the costs of the resources which must be devoted to it.

From time to time, proposals or inquiries are received about potential projects that do not fully meet the requirements for existing programs or, in some cases, overlap two or more programs.

The Directorate for Science Education will entertain such proposals if the project put forward meets the following conditions:

- Relates to the broad objectives of the Directorate;
- Falls outside the guidelines of existing programs; and
- Shows promise of providing information and experience useful to the Directorate in improving effectiveness of existing programs or in designing new programs for the future.

Proposals meeting these criteria will be considered individually and may be submitted at any time. Prospective applicants must establish initial contact with a Directorate staff member by phone or by a brief letter of inquiry that describes the intended project.

The following summary provides a brief description of the programs of the Science Education Directorate. These descriptions are not intended to be used as guides for the preparation of proposals. A separate guide for each of the programs will be available for this purpose. These program guides are identified in the description of each program and should be requested separately. The guides should be carefully followed in the development of proposals.

Requests for publications SE 79-10 and SE 79-13 (Graduate Fellowships, and National Needs Postdoctoral Fellowships) should be addressed to:

Fellowship Office
National Research Council
2101 Constitution Ave., N.W.
Washington, D.C. 20418

Requests for all other guides are to be addressed to:

Mail, Security, and Records Section
Attention: Publications Unit
National Science Foundation
Washington, D.C. 20550

Program brochures are currently available unless otherwise indicated in the text.

Other inquiries related to a particular program should be directed to the individual program concerned.

Science Education Resources Improvement

In an effort to improve the capabilities of schools, colleges, and universities for education and research training in the sciences, the Division of Science Education Resources Improvement supports the following programs:

Comprehensive Assistance to Undergraduate Science Education

The program of Comprehensive Assistance to Undergraduate Science Education (CAUSE) is designed to encourage improvement in the quality and effectiveness of undergraduate science education in the Nation's colleges and universities.

The program's primary objectives are to:

- Strengthen the undergraduate science education components of 2- and 4-year colleges and universities;
- Improve the quality of science instruction at the undergraduate level; and
- Enhance institutional capability for self-assessment and continuing updating of their science programs.

To achieve these objectives, the Foundation provides funding for a period of up to 3 years in response to meritorious plans prepared by academic institutions, subunits of institutions, or associations of institutions.

Request brochure SE 79-30, *Comprehensive Assistance to Undergraduate Science Education*. The closing date for receipt of proposals in the Foundation is December 4, 1978, and awards will be announced in May 1979.

If questions arise for which SE 79-30 does not provide answers, write to:

Comprehensive Assistance to Undergraduate Science Education
Division of Science Education Resources Improvement
National Science Foundation
Washington, D.C. 20550

Minority Institutions Science Improvement

The Minority Institutions Science Improvement Program (MISIP) provides support for improvement projects in 2- and 4-year colleges whose enrollments are composed predominantly of American Indian, Black, Mexican American, Puerto Rican, or other disadvantaged ethnic minorities underrepresented in science. The support is provided to effect long-range improvement in the basic scientific strength of these institutions. To qualify for Foundation support, an institution must present a plan for development that can be maintained after grant termination. Renovation of facilities, purchase of equipment, and development of methods of instruction are some elements that may be supported under this program.

Request brochure SE 79-31, *Minority Institutions Science Improvement*. The closing date for receipt of proposals in the Foundation is December 4, 1978. Awards will be announced in May 1979.

If questions arise for which SE 79-31 does not provide answers, write to:

Minority Institutions Science
Improvement
Division of Science Education
Resources Improvement
National Science Foundation
Washington, D.C. 20550

Local Course Improvement

Local Course Improvement awards are made on a competitive basis for individual science faculty members or small groups of science faculty to make relatively short-term, concentrated efforts at changing their undergraduate science instructional programs. Projects typically concentrate on the design, preparation, and evaluation of new materials or laboratory experiments. Projects may focus on any undergraduate instructional activity in science, including courses intended for science majors, nonscience majors, those preparing specifically for careers as teachers of elementary and secondary school science, or students preparing for technological careers. The Local Course Improvement program seeks a broad distribution of awards nationally and across the variety of scientific and engineering disciplines.

Request brochure SE 79-34, *Local Course Improvement*. The closing date for receipt of proposals is October 3, 1978, and awards will be announced in April 1979.

If questions arise for which SE 79-34 does not provide answers, write to:

Local Course Improvement
Division of Science Education
Resources Improvement
National Science Foundation
Washington, D.C. 20550

Instructional Scientific Equipment

The Instructional Scientific Equipment program provides partial support for the acquisition of scientific equipment required for undergraduate instruction in the sciences. Universities, colleges, and 2-year colleges in the United States or its territories are eligible for support. Grants are made on a matching funds basis in which the grantee provides at least 50 percent of the cost of the equipment.

Request brochure SE 79-32, *Instructional Scientific Equipment*, which will be available in November 1978. The closing date for receipt of proposals in the Foundation is March 1, 1979, and awards will be announced in September 1979.

If questions arise for which SE 79-32 does not provide answers, write to:

Instructional Scientific
Equipment
Division of Science Education
Resources Improvement
National Science Foundation
Washington, D.C. 20550

Information Dissemination for Science Education

The Information Dissemination program seeks to assist State and local education decision-makers in becoming familiar with choices of classroom materials, practices, and technologies which can be used to improve education in precollege science and mathematics. To this end, support will be given for conferences and other information exchange activities to provide opportunities for administrators, subject-matter specialists, teacher-leaders, school board members, and other policymakers to make more informed choices.

Request brochure SE 79-33, *Information Dissemination for Science Education*. Closing date for receipt of proposals is January 10, 1979, with awards to be announced in June 1979.

If questions arise for which SE 79-33 does not provide answers, write to:

Information Dissemination for
Science Education
Division of Science Education
Resources Improvement
National Science Foundation
Washington, D.C. 20550

Resource Centers for Science and Engineering

The Resource Centers for Science and Engineering program seeks to expand the options in science and engineering of minority students and students from low income families. This program will assist graduate institutions to increase the number of minority graduate students and minority doctorates in science, to increase the participation in science by students from low income families, to provide minority students with role models and research opportunities with established scientists, and to provide minority faculty with academic research career options and to increase their scholarly productivity.

In fiscal year 1979, if funds are available, support will be provided for the establishment of three centers geographically located near one or more population centers of low income families or minority groups, which will (1) support basic research, (2) serve as a regional resource in science and engineering, and (3) develop joint educational programs with nearby pre-college and undergraduate institutions enrolling substantial numbers of minority students or students from low income families.

Request brochure SE 79-36, *Resource Centers for Science and Engineering*. Closing dates for receipt of proposals and date of award will be included in the brochure.

If questions arise for which SE 79-36 does not provide answers, write to:

Resource Centers for Science
and Engineering
Division of Science Education
Resources Improvement
National Science Foundation
Washington, D.C. 20550

Scientific Personnel Improvement

The Foundation's Scientific Personnel Improvement programs are designed to meet the following objectives:

- To assure that some of the Nation's most talented graduate students in the sciences obtain the education necessary to become first-line scientific researchers.
- To train or upgrade the scientific personnel specifically needed to help meet identified national needs.
- To promote graduate training in the sciences at institutions that have traditionally served ethnic minorities.
- To provide new knowledge and updating experience for science teachers.
- To expose a small number of the most scientifically talented high school and college students to research activities.
- To develop and test methods to stimulate the participation in science by women, minorities, and the physically handicapped.

Graduate and Postdoctoral Programs

Graduate and Postdoctoral programs provide support for study toward a post-baccalaureate degree in science to a small number of highly qualified graduate students and to postdoctoral students in areas of national needs.

Distinction is made between *fellowship* programs, in which individuals apply directly to the program, and *traineeship* programs, in which institutions apply to NSF for funds to support individuals whom they will select.

Graduate Fellowships

This program provides fellowship support to graduate students for study or work toward a master's or doctoral degree in a broad spectrum of scientific disciplines. It is expected that in fiscal year 1979 the nationally competitive Graduate Fellowship program will provide approximately 400 new 3-year fellowships, to be awarded to beginning graduate students.

The competition is open only to citizens or nationals of the United States. The Foundation is concerned with the underrepresentation of ethnic minorities and women in the scientific personnel pool and specifically encourages applications from these groups.

For the program announcement SE 79-10, *Graduate Fellowships*, write to:

Fellowship Office
National Research Council
2101 Constitution Ave., N.W
Washington, D.C. 20418

The deadline for receipt of applications in this program is November 30, 1978, for fellowship support beginning with the 1979-80 academic year. Awards will be announced in March 1979.

Minority Graduate Fellowships

This program was established in fiscal year 1978 to provide fellowship support to members of ethnic minority groups which traditionally have been underrepresented in the advanced levels of the Nation's science talent pool. Under this program, support is provided to minority graduate students for study or work toward master's or doctoral degrees in science fields supportable by NSF. It is anticipated that approximately 50 new 3-year Minority Graduate Fellowships will be awarded in fiscal year 1979.

Competition in this program is open only to citizens or nationals of the United States who are American Indian, Black, Eskimo or Aleutian, Mexican American, or Puerto Rican.

For program information, write for program announcement SE 79-12, *Minority Graduate Fellowships*. The deadline for receipt of applications is December 1, 1978, for fellowship support beginning with the 1979-80 academic year. Awards will be announced in March 1979.

If questions arise for which SE 79-12 does not provide answers, write to:

Graduate and Postdoctoral Programs
Division of Scientific Personnel
Improvement
National Science Foundation
Washington,D.C. 20550

National Needs Postdoctoral Fellowships

This program assists in providing training to recent postdoctoral scientists and engineers to strengthen their research capabilities in areas of national need. Fellowships will be awarded on the basis of demonstrated aptitude and potential for research related to national needs. Fellows will receive stipends to allow them to undertake up to a year of research or advanced study.

The competition is open only to citizens or nationals of the United States who have received their doctorates within the past 5 years.

For program information, request brochure SE 79-13, *National Needs Postdoctoral Fellowships*, available from:

Fellowship Office
National Research Council
2101 Constitution Ave., N.W.
Washington, D.C. 20418

The deadline for receipt of applications is November 3, 1978. Awards will be announced in March 1979.

Minority Institutions Graduate Traineeships

This program provides awards to U.S. institutions having a predominately minority enrollment, to enable them to support 3-year graduate traineeships.

Institutions in this category that offer graduate training in the sciences can obtain information concerning the program by writing for brochure SE 79-15, *Minority Institutions Graduate Traineeships*. The deadline for submission of institutional proposals is December 15, 1978. Awards will be announced in early April 1979.

After announcement of awards, graduate students seeking support under this program should apply directly to the awardee institutions, not to the National Science Foundation. As is the case for other NSF fellowship and traineeship programs, appointments will be made only to persons who are citizens or nationals of the United States.

If questions arise for which SE 79-15 does not provide answers, write to:

Minority Institutions Graduate
Traineeships
Division of Scientific Personnel Improvement
National Science Foundation
Washington, D.C. 20550

NATO Postdoctoral Fellowships in Science

At the request of the Department of State, the Foundation administers this program for the North Atlantic Treaty Organization (NATO). Awards are made to U.S. citizens for full-time postdoctoral study in science in countries that are members of NATO (other than the United States) or in other countries which cooperate with NATO. Approximately 50 awards will be made in fiscal year 1979 to outstanding individuals who have recently received (or will soon receive) doctoral degrees in science. This program is designed primarily for applicants who have received their doctorates within the past 5 years.

For the program announcement, request brochure SE 79-17, *NATO Postdoctoral Fellowships in Science*. The deadline for receipt of applications is November 3, 1978, with award announcement to be made in April 1979.

If questions arise for which SE 79-17 does not provide answers, write to:

NATO Postdoctoral Fellowships
in Science
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Travel Grants for NATO Institutes

The Foundation awards travel grants to enable young U.S. scientists to attend certain NATO Advanced Study Institutes. These meetings are usually held during the summer and vary in length from 1 to 8 weeks. Grants normally cover the cost of the round-trip air fare involved. The directors of the NATO Advanced Study Institutes nominate U.S. citizens for these awards from among those accepted to their institutes. Therefore, individuals should make their interest in a NATO Travel Grant known to the director of the institute to which they have been admitted. Lists of institutes receiving such support are available from the Foundation in early March, at which time information about application procedures will be made available.

Additional Information

For additional information about *any* of the Graduate and Postdoctoral programs, write to:

Graduate and Postdoctoral
Programs
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Faculty Improvement Programs

The Faculty Improvement programs provide support for both pre-college and college teachers to receive additional training or research experience in their fields. Opportunities for primary and secondary school science teachers include summer and academic year activities conducted in cooperation with local and regional college and university faculty. Opportunities for college faculty include short courses and fellowship-like activities in support of research and study in academia or industry.

College Faculty Short Courses

This program provides a forum in which scholars at the frontiers of various disciplines communicate recent advances in their fields directly to college teachers of science. The primary aim is to enable college-teacher participants to keep their teaching up to date and relevant.

To meet this objective, the Foundation supports Chautauqua-Type Short Courses which are conducted by the American Association for the Advancement of Science and the University of Missouri, Kansas City. Approximately 136 courses will be offered at 15 regional field centers. Each course meets for a total of 4 days—2 in the fall and 2 in the spring. Between the two sessions, participants work on course-related projects designed to enhance the teaching technique of participants. Courses are open to science, engineering, and mathematics teachers of undergraduate students. A qualified teacher may apply at any field center. Selection of participants is carried out by the field center coordinators.

Information about these courses may be obtained by writing:

Chautauqua-Type Short Courses
Box B, AAAS
1776 Massachusetts Ave., N.W.
Washington, D.C 20036

Pre-College Teacher Development

The Pre-College Teacher Development program provides opportunities for elementary and secondary school teachers to strengthen their science subject-matter knowledge and improve their instructional skills. Support is provided to colleges and universities that offer at least a baccalaureate degree in science to conduct academic year seminars and summer workshops. Projects are characterized, in general, by a group of elementary and secondary school teachers engaged in a learning experience sponsored by the grantee institution and staffed by individual faculty or others selected for their appropriate expertise. A wide variety of proposals responding to particular local, regional, or national needs are welcome.

Request brochure SE 79-27, *Pre-College Teacher Development*. The deadline for receipt of proposals is October 15, 1978, with awards to be announced in March 1979.

If questions arise for which SE 79-27 does not provide answers, write to:

Faculty Improvement Programs
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Science Faculty Professional Development

This program provides awards on a competitive basis to faculty members engaged in undergraduate education at community colleges, 4-year colleges, and universities. Individuals may request support for research and/or graduate studies in appropriate profit or nonprofit institutions, including industrial and Government laboratories. The program aim is to help experienced, full-time 2- and 4-year college and university science teachers who are involved primarily in undergraduate science instruction to increase their competence in science so as to improve the capability of science students in meeting current employment requirements.

Request brochure SE 79-28, *Science Faculty Professional Development*. The deadline for receipt of proposals is December 4, 1978, with announcement of awards to be made in April 1979.

If questions arise for which SE 79-28 does not provide answers, write to:

Faculty Improvement Programs
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Student-Oriented Programs

Student-Oriented programs have three related goals: (1) to provide talented students with science learning opportunities beyond those normally available in formal science programs in schools and colleges; (2) to increase the variety of instructional patterns by demonstrating the capacity of students to accept greater responsibility for planning and carrying out their own learning activities; and (3) to identify and encourage science and engineering talent.

Through each of three separately described programs—Secondary School Student Science Training, Undergraduate Research Participation, and Student-Originated Studies—support is provided for projects that encourage students to develop their ability to operate more independently and assume greater responsibility for their own learning.

Secondary School Student Science Training

Secondary School Student Science Training projects support summer science programs, organized by academic and other nonprofit institutions with appropriate scientific and educational expertise, to provide high ability high school students with research experience or college-level instruction in science and mathematics.

Request brochure SE 79-20, *Student Science Training Program*. Proposal deadline is August 25, 1978, with awards to be announced in January 1979.

Undergraduate Research Participation

The Undergraduate Research Participation program provides support for undergraduates who have completed a substantial portion of their requirements in science to work full time during the summer directly with faculty members on research projects. In addition, a limited number of projects arranged by science faculty members will place undergraduates in an industrial laboratory where the students will be under the direction of an industrial scientist.

This program will be supported in fiscal year 1979 if funds are available.

Request brochure SE 79-21, *Undergraduate Research Participation*. Proposal deadline is September 15, 1978, with awards to be announced in January 1979.

Student-Originated Studies

The aim of Student-Originated Studies is to provide teams of college students with experience in independent, self-directed study, and to demonstrate the effectiveness of such study as an adjunct to or replacement for portions of their traditional formal course work.

Each study is conducted by a group of students comprised primarily of undergraduates. Each project deals with a local problem that has immediate relevance to the community. The projects are wholly student-originated and managed, with faculty in an advisory role. There is a general requirement that studies be conducted by multidisciplinary groups and be concerned with problems of the physical, biological, or social environment.

This program will be supported in fiscal year 1979 if funds are available.

Request brochure SE 79-22, *Student-Originated Studies.* Proposal deadline is November 3, 1978, with awards to be announced in March 1979.

Additional Information

If questions arise for which SE 79-20, SE 79-21, or SE 79-22 do not provide answers, write to:

Student-Oriented Programs
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Minorities, Women, and the Physically Handicapped in Science

The Minorities, Women, and the Physically Handicapped in Science program seeks to increase the entry or re-entry into scientific careers of women, minorities, and the physically handicapped.

Women in Science

The objective of the Women in Science program is to develop and test methods to attract women to and retain them in science careers. In fiscal year 1979 proposals will be supported for Science Career Workshops. The specific objectives of the workshops are to counsel and give practical career advice to women who are undergraduate or graduate students in science. These are to be 1 or 2 days in length, multidisciplinary, and carried out by colleges and universities.

Request brochure SE 79-26, *Women in Science,* for guidelines for the submission of proposals.

The Foundation will consider other proposals designed to accomplish the primary objectives of this program provided the proposal is received before the deadline specified in SE 79-26 and the proposal is judged highly meritorious, relevant, timely, and cost-effective.

Minorities in Science

The objective of this program is to provide individual minority students with additional special science learning opportunities. The funding of minority-focused projects is accomplished through two existing student-oriented programs—Student Science Training for high school students, and Undergraduate Research Participation for undergraduates. Prospective proposers should consult the Student Science Training and Undergraduate Research Participation programs, described on page 34 of this *Guide to Programs.* Other proposals meeting the primary objective of this program will be considered if received prior to the deadline specified for Student Science Training and if judged to be highly meritorious, relevant, timely, and cost-effective.

Physically Handicapped in Science

As a result of a new effort to increase the representation of the physically handicapped in scientific research and education, communications have been established with institutions having experience in this area, and proposals are being solicited.

Proposals may be submitted by colleges, universities, schools for the handicapped, and nonprofit organizations. Priority will be given to four types of projects: (1) conferences, (2) workshops, (3) studies, and (4) science training models which directly involve groups of handicapped students.

Guidelines for the preparation and submission of proposals may be requested directly from:

Physically Handicapped in
Science Program
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

The deadline for receipt of proposals is December 7, 1978.

Additional Information

For additional information on the Minorities, Women, and Physically Handicapped in Science program, write to:

Minorities, Women, and the
Physically Handicapped in Science
Division of Scientific Personnel
Improvement
National Science Foundation
Washington, D.C. 20550

Science Education Development and Research

The Division of Science Education Development and Research supports research projects designed to generate new knowledge about the science education process; development projects designed to produce, test, and evaluate innovative instructional materials, delivery modes, and curricula; and needs and problem assessments. Only projects that promise to improve science education in a national sense will be considered for support.

Development in Science Education

This program supports the development of innovative or experimental projects for the improvement of science education. In fiscal year 1979, the following areas of activity will be emphasized:

- Science for the early adolescent
- Technology as applied to learning
- Education and national productivity
- Broadening access to careers in science

Projects may be for the development of specific materials or for the creation and trial of new educational approaches, either within or outside of a formal academic setting.

Request brochure SE 79-50, *Development in Science Education*. Proposal deadline announcement dates are indicated in the brochure.

If questions arise for which SE 79-50 does not provide answers, write to:

Development in Science Education
Division of Science Education
Development and Research
National Science Foundation
Washington, D.C. 20550

Research in Science Education

This program supports research projects designed to generate new knowledge that will result ultimately in the creation and utilization of more effective science education or more efficient uses of educational resources. Consideration will be given to projects intended to help define areas in which development and research are needed and those which provide a knowledge base for solving science education problems. Projects are limited to study in the areas of natural and social sciences, mathematics, and engineering.

Specific information about this program will be contained in brochure SE 79-55, *Research in Science Education*, expected to be available in November 1978. The proposal deadline and award announcement dates will be indicated in the brochure.

If questions arise for which SE 79-55 does not provide answers, write to:

Research in Science Education
Division of Science Education
Development and Research
National Science Foundation
Washington, D.C. 20550

Joint NIE-NSF Research Program

This program, administered in collaboration with the National Institute of Education, provides support for research aimed at developing a fundamental understanding of what people know as they achieve mastery of an area of scientific or mathematical knowledge or a scientific or mathematical skill. Projects eligible for this program will be necessarily interdisciplinary in nature, requiring expert knowledge of a scientific subject, sophistication in the methods and principles of cognitive psychology, and experience with instruction at the appropriate level. Projects should focus upon topics which are of recognizable importance in science and mathematics for students in the age range from elementary school to introductory college level. Activities such as curriculum or test development, literature surveys, program operation, or dissemination (such as conferences) are *not* eligible for support except as necessary for the conduct of research which is eligible under the program.

Specific information about this program will be contained in brochure SE 79-53, *Joint NIE-NSF Research Program*, expected to be available in October 1978. The proposal deadline dates will be reported in the brochure.

If questions arise for which SE 79-53 does not provide answers, write to:

Joint NIE-NSF Research Program
Division of Science Education
Development and Research
National Science Foundation
Washington, D.C. 20550

Continuing Education for Scientists and Engineers

Activities in continuing education for scientists and engineers will extend and round out those begun in fiscal year 1978. Studies needed to complete and expand the effort to define the current status and structure of continuing education, and investigations of the practicability of quantitative and qualitative evaluation of continuing education offerings according to nationally acceptable standards will be funded. In addition, feasibility studies or initiation of cooperative planning related to coordination of the continuing education activities of industry, professional societies, entrepreneurs, and academic institutions will be considered. Attention will also be given to projects that explore means for improving the transfer of information among industrial and academic institutions.

Request brochure SE 79-58, *Continuing Education for Scientists and Engineers*, expected to be available in October 1978. Proposal closing and award announcement dates will be indicated in the brochure.

If questions arise for which SE 79-58 does not provide answers, write to:

Continuing Education for Scientists
and Engineers
Division of Science Education
Development and Research
National Science Foundation
Washington, D.C. 20550

Science and Society

The integrating focus of the three Office of Science and Society programs grows out of the changing relationship between the scientific and technological communities and the society of which they are a part. The increased specialization and institutionalization of science and technology and their pervasive influence on contemporary life have added to a growing concern about the ethical implications and social consequences of these activities. The problem of "accountability" has emerged as a central social issue affecting science no less than Government, business, education, and other major institutions. In effect, the implicit social contract that exists between science and society is now in the process of renegotiation. It is the distinctive task of these programs to try to bring about greater understanding and facilitation of this process, both among the general public and within the scientific and technological communities themselves, and to facilitate informed public participation in the resolution of significant public issues involving science and technology.

In pursuing these tasks the programs seek to respond to questions such as: How do the activities of scientists affect our lives? How and by whom are decisions made about the direction of scientific activities and the resources invested in them, and how should these decisions be made in a democratic society? Against what ethical and social standards can and should they be judged? How can citizens who are not scientists participate effectively in public policy decisions with important scientific and technological components?

Public Understanding of Science

This program seeks to improve the scope, level, and quality of information about science and technology addressed to the general public, especially with respect to the scientific and technological content of major public issues, and to improve the techniques of distribution and dissemination of information about science and technology to nonscientists.

The Public Understanding of Science program supports projects that make use of a wide variety of communications techniques and media. Many projects are aimed at special audiences, such as minority groups, rural populations, senior citizens, and union members. Increased emphasis will be given in fiscal year 1979 to projects designed to raise the quality and breadth of media presentation of scientific and technological events. The nature and implications of alternative technologies of energy, food production, and oceanic resource development are representative of the important policy issues which are given high priority.

Proposals may be submitted by colleges, universities, laboratories, museums, State and local government agencies, professional associations and societies, citizens groups, and other profit and nonprofit organizations interested in improving the public understanding of science.

Preliminary proposals enable the staff to determine whether a project is relevant to the program's objectives and to provide appropriate assistance to the applicant in the preparation of a formal proposal. Preliminary proposals may be submitted at any time.

Formal proposals will be considered three times a year. Deadline dates for receipt of formal proposals are December 1, 1978; April 1, 1979; and August 1, 1979. Every effort will be made to announce decisions on funding within 6 months after each deadline for the submission of formal proposals.

Request brochure SE 79-60, *Public Understanding of Science*, for guidelines for the submission of proposals. Award information is included in SE 79-60.

If questions arise for which SE 79-60 does not provide answers, write to:

Public Understanding of Science
Office of Science and Society
National Science Foundation
Washington, D.C. 20550

Ethics and Values in Science and Technology

The central concern of the Ethics and Values in Science and Technology (EVIST) program is with the ethical rules and social standards that govern the conduct of scientific and technological activities, including the selection of research priorities and the application of research results. These concerns extend from issues associated with the conduct of individual scientists and engineers and their professional organizations and institutions to those arising out of the more general interactions of science, technology, and society.

The goal of the program is to support projects that will make a significant contribution to refining and enlarging the professional and public debate on these questions. Accordingly, highest priority is assigned to projects that deal with issues of demonstrable importance to nonspecialists in science and ethics, and that include a well developed plan for disseminating their results to as broad a range of concerned individuals and groups as possible.

The EVIST program supports experimental institutes and workshops, national and international conferences and symposia, analytical and case-study research, and the preparation of reference materials.

Proposals may be submitted by colleges, universities, laboratories, industrial firms, citizen groups, State and local governments, professional associations, and other profit and nonprofit organizations. Proposals from individuals acting independently of institutional sponsorship will be considered only under exceptional circumstances.

Certain proposals may be considered for joint support by EVIST and one or more other programs within the Foundation or in other Federal agencies, particularly the National Endowment for the Humanities (NEH). Inquiries to NEH should be directed to:

Program of Science, Technology,
and Human Values
Office of Planning
National Endowment for the
Humanities
Washington, D.C. 20506

Request brochure SE 79-62, *Ethics and Values in Science and Technology*, for guidelines for the submission of proposals. Deadlines for receipt of formal proposals are December 1, 1978; April 1, 1979; and August 1, 1979. A preliminary proposal must be submitted prior to the submission of a formal proposal. Award information is included in the brochure.

If questions arise for which SE 79-62 does not provide answers, write to:

Ethics and Values in Science
and Technology
Office of Science and Society
National Science Foundation
Washington, D.C. 20550

Science for Citizens

The goal of the Science for Citizens program is to increase the knowledgeable participation of scientists and nonscientists in the resolution of public policy issues involving science and technology. Projects supported by this program are intended to facilitate the interaction of scientists with citizens and citizen groups that ordinarily lack access to scientific and technical information and expertise, and to provide balanced and objective information that will help clarify and resolve policy issues having significant scientific and technical aspects.

In the 2 years of the program's existence, it has conducted two principal kinds of activities: (1) Public Service Science Residencies (for professional scientists and engineers) and Public Service Science Internships (for students of science and engineering), which are designed to encourage qualified persons to initiate or participate in activities aimed at the resolution of public policy issues involving science and technology; and (2) forums, conferences, and workshops intended to achieve the same objectives, sponsored by citizen groups and other nonprofit organizations. The Science for Citizens program is also exploring, by the use of planning study grants, the possible development of mechanisms designed to make scientific information and expertise more widely available to all citizens in the ways and at the time most useful to them.

For further information, write to:

Science for Citizens
Office of Science and Society
National Science Foundation
Washington, D.C. 20550

IV. Applied Science and Research Applications

The National Science Foundation Act was amended by Congress in 1968 to broaden Foundation authority and responsibilities in the area of applied research. In 1971 the Research Applied to National Needs (RANN) program was initiated. In 1976 the Foundation established a Science Applications Task Force to reassess NSF's role in applied research, to examine NSF's science applications activities, and to recommend changes that might further strengthen them. The Task Force submitted recommendations to the Director and the National Science Board in August of 1977.

The Board in turn approved plans for the new Applied Science and Research Applications (ASRA) Directorate to: (1) more sharply focus Foundation activities on a selected number of research applications where NSF can make a unique contribution; (2) strengthen the links between the basic research activities and the applied research activities of NSF; (3) improve the ties between research applications activities and user groups in State and local government, private industry, and other Federal mission agencies; and (4) provide a funding source for high quality applied research proposals from the scientific community where such research falls outside the scope of the Foundation's basic research units, the focused research programs of ASRA, or the research programs of other mission agencies.

The new ASRA Directorate is organized around five subactivities: Problem Analysis, Integrated Basic Research, Applied Research, Problem-Focused Research Applications, and Intergovernmental Science and R&D Incentives.

The five problem areas that comprised the RANN program (i.e., Resources, Environment, Productivity, Intergovernmental Science and R&D Incentives, and Exploratory Research and Problem Assessment) have been reviewed and their components phased out, transferred to other parts of NSF, or reassigned to the most appropriate part of the new activity. The focused research programs being phased out are:

- *Resources*—nonconventional food research; resource development and conservation; mineral processing technology.
- *Environment*--land-use policy; societal response to natural hazards.
- *Productivity*—productivity measurement; distribution and equity; medical instrumentation technology; systems analysis; excavation technology.

In each of the program areas being phased out, ASRA will meet previously made RANN commitments within the funds available. Unsolicited proposals in these areas will still be eligible to compete for support under the new Applied Research program.

Eligibility

Proposals may be submitted by colleges, universities, public or private laboratories, industry (including small businesses), and other organizations whether operating for profit or on a not-for-profit basis, as well as by State, regional, and local units of government and individuals without organizational affiliation.

Proposals are expected to offer a significant scientific or technical contribution, a utilization component, and show strong relevance to ASRA program objectives. Joint proposals from combinations of universities, nonprofit institutions, industry, small business, and State, regional, and local units of government are encouraged, as appropriate, to bring together broader capabilities and interdisciplinary and management skills to provide a comprehensive approach to complex problems.

Deadlines

Unsolicited proposals may be submitted at any time. Review and award processes are continual.

Proposals received too late for consideration in one fiscal year are considered in the following year. If a specific starting date for the project is important, the circumstances should be clearly explained and at least 6 months lead time allowed for review and processing.

Additional Information

Communications relating to a specific program area may be addressed to the appropriate division or office: Division of Integrated Basic Research, Division of Applied Research, Division of Problem-Focused Research Applications, Division of Intergovernmental Science and R&D Incentives, and Office of Problem Analysis. General inquiries may be addressed to: Programs and Resources Officer, Directorate for Applied Science and Research Applications, National Science Foundation, Washington, D.C. 20550. Requests for publications may be addressed to: ASRA Information Resources, Directorate for Applied Science and Research Applications, National Science Foundation, Washington, D.C. 20550.

Problem Analysis

The Problem Analysis program seeks to identify and analyze major national problems with significant scientific content to provide a preliminary assessment of the appropriate role of science and technology, the Federal Government, and the NSF in their solution. The program will provide analyses of a wide range of potential research topics and problem areas for use in selecting research directions and allocating resources among existing or emerging new program thrusts.

Suggestions for new areas of applied research or modifications of existing programs will be examined in line with the following questions:

- What is the nature of the problem and what issues are researchable?
- Will new or additional research have a potential high payoff either through a better understanding of the problem or the development of a technical base which will contribute to its solution?
- What research is currently under way on the subject and what are its sources of support?
- What is the size and capability of the research community to address the problem?
- What is the most appropriate organization for supporting any additional research? Is there a unique role for NSF and ASRA?

The Problem Analysis program relies on a variety of inputs and mechanisms to provide answers to these questions. Input from research performers, scientific and professional societies, user groups, advisory committees to the Foundation, and interagency panels and working groups is obtained through special studies, analyses, seminars, and workshops.

Examples of areas currently being examined include, but are not limited to, science and technology to aid the physically handicapped, appropriate technology, long-term economic growth under resource and environmental constraints, arid and semi-arid land management, environmental design, and nutrition.

Integrated Basic Research

The Division of Integrated Basic Research (IBR) was created to provide incremental support to basic research topics related to problem areas of existing or emerging major importance where additional basic understanding is likely to contribute to their long-term solution. Topic areas are to be identified by a broad consultative process and will be described in separate announcements.

IBR will not accept proposals directly from the research community. To accomplish its objectives, IBR will provide support for proposals which have been: (1) submitted to the basic research components of the Foundation in accordance with the NSF publication *Grants for Scientific Research* (NSF 78-41); (2) favorably reviewed under the provisions of the National Science Board policy statement, Criteria for the Selection of Research Projects, on page v of this *Guide to Programs;* and (3) recommended to IBR for support by the appropriate basic research program director.

Applied Research

The Division of Applied Research seeks to accelerate the rate of technological innovation growing out of significant advances in selected fields of science and engineering and to provide information of relevance to public policy issues requiring a high degree of scientific input.

These objectives are accomplished in two ways. First, the Division will support unsolicited applied research projects on problems of the investigators' own choosing that build upon discoveries in one or more of the basic sciences. Second, the program will identify certain technological opportunities or policy areas where the selective support of interrelated applied research projects has a high probability of providing a broad knowledge base for major technological innovations or for contributing to the solution of significant public policy issues. These "coherent areas" will encourage and support unsolicited projects on problems relating to these topics. Current areas of special emphasis are: Telecommunications; Growth, Income, and Employment; Public Regulation of Economic Activity; and Production Research and Technology.

Proposals for applied research projects may come directly from the scientific and engineering research communities or be referred by one of the Foundation's basic research programs. Proposals will be competitively evaluated in terms of their scientific merit and their potential long-term utility. Proposals considered as part of a "coherent area" compete for funding against unsolicited proposals submitted to the program for research in other problem areas.

The Applied Research Division carries out the objectives through two interrelated programs: Applied Social and Behavioral Sciences, and Applied Physical, Mathematical, and Biological Sciences, and Engineering. Each emphasizes applied research based on a broad range of scientific disciplines.

Applied Social and Behavioral Sciences

The objectives of this program are to provide an improved understanding of a broad range of significant economic, social, and technical problem areas and to suggest alternative solutions to these problems. Research oriented towards public policy, public service delivery, and industrial organizational issues is encouraged. Proposed research must clearly strengthen understanding of these issues, including improving the breadth and quality of possible choices and potential solutions.

The program will consider all proposals for applied research in the social and behavioral sciences. However, experience has shown that the majority fall into the following categories:

- **Public Policy and Regulation—**More and better information on policy issues of national concern such as unemployment, international trade, regulation, telecommunications, inflation, and the use of scientific and technical information in judicial and administrative decision-making. Projects must clearly identify the policy issues of concern and the intended users of the information produced.
- **Public Service Delivery and Urban Problems—**Improved information on the changing character of urban areas in the United States, the changing demands for services, alternative mechanisms for improving governmental responsiveness to service needs, and improvements in the effectiveness and equity of service delivery by both the public sector and private market. Projects must clearly identify the intended users and give an indication of how the information will be effectively communicated outside of the research community.
- **Industrial Organizations and Markets—**Improved understanding of public and private

processes, organizational structures, and policies as they relate to industrial organization and performance and to the effective use of human, capital, and natural resources within the American economic system. These studies will apply research findings and methodologies developed in anthropology, industrial sociology and psychology, political science, and economics to such things as analyses of market forces and the industrial uses of natural resources; examinations of the impacts of technological innovation on the structure of work and work incentives; the cost of capital to industry; and the structure and organization of industry. Projects must clearly identify the intended users and indicate how the research results will be communicated in an effective manner.

- **Individual and Group Processes**—Development of new technologies and technical processes growing out of discoveries in the behavioral sciences. Activities often involve multidisciplinary research groups from various fields of engineering and computer science, along with behavioral scientists working on applications ranging from new technologies for the blind or other sensory deprived individuals to new communications and control devices for industrial applications.

Applied Physical, Mathematical, and Biological Sciences, and Engineering

The Applied Physical, Mathematical, and Biological Sciences, and Engineering program seeks to increase the rate of technological innovation growing out of discoveries in various fields of science and to accelerate the application and use of these technologies to improve the breadth and quality of long-range solutions to significant social, economic, and technical problems and policy issues that confront the United States.

The program will consider all proposals for applied research in the physical, mathematical, and biological sciences, and engineering. There will be a special emphasis on work related to industrial automation and production technology.

Technological opportunities and application support will be provided in the following areas:

- **Biological and Ecological Applications**—Accelerate the rate of technological innovations based on basic advances in the biological and ecological disciplines, including exploring the potential of genetic manipulations for the economical production of new materials; the use of protoplast fusion to speed tests of new plant materials; the modeling, and management of ecosystems as a way of increasing the effective use of land, energy, and water and our renewable resources capabilities; and improving information on the links between ecosystems and economic and social systems as a way of improving the information base for formulating public policies that affect our national resources.
- **Geophysical and Environmental Applications**—Accelerate the rate of technological innovations based on advances in the oceanographic and earth sciences, including methods for exploiting ocean resources, techniques for utilizing coastal and estuary areas for resource production, and the improvement of techniques and sensing devices for exploration and extraction of minerals from land areas.

Problem-Focused Research Applications

The Division of Problem-Focused Research Applications has as its goal the application of U.S. scientific and technological capabilities to selected societal problems of critical national importance in those instances where the absence of such application is clearly a barrier to problem clarification or resolution. Programs are structured around specific problems. The type and number of programs will change over time as new problems are selected and as ongoing programs are transferred or phased out.

Each program has the following characteristics:

- It is an activity for which recognizable and generally measurable public benefits will accrue;
- It has wide geographical and social applicability;
- It requires the application of results from

many scientific disciplines and professions;

- It intends to contribute to problem solution rather than to increase the depth or breadth of knowledge in any basic discipline;
- It provides results useful to the public and private sectors where disciplinary constraints, fragmentation, regulation, or lack of market incentives inhibit research initiatives by others.

There are currently four program areas in which proposals may be submitted in Problem-Focused Research Applications: Earthquake Hazards Mitigation, Chemical Threats to Man and the Environment, Alternative Biological Sources of Materials, and Community Water Management. Each program concentrates research and proof-of-concept experiments on selected problem areas in order to: facilitate the incorporation of science as a working tool for problem resolution in the public and private sectors; provide support for problem-focused research that bridges from basic research discoveries to applications; and enhance the capability and capacity of nontraditional research users to employ research results and methods.

Earthquake Hazards Mitigation

At the request of the President, a report on *Earthquake Prediction and Hazard Mitigation Options for U.S. Geological Survey and National Science Foundation Programs* was prepared and submitted in September 1976. The report presents options for future development of a combined National Science Foundation-U.S. Geological Survey research program. Under the option selected by the Executive Branch for implementation, the Earthquake Hazards Mitigation program is responsible for earthquake engineering and research for utilization. This responsibility is carried out through the following research areas:

- **Siting**—Data on the nature of earthquake motion at typical construction sites and for representative structures; the physical basis for characterizing the nature of earthquake motions and the dynamic forces generated by such motions and by other natural hazards; capabilities for prediction of the magnitude and frequencies of ground motions; methodology for qualitative and quantitative estimates of local or regional risk associated with earthquakes and combined hazards; a comprehensive and unified program to improve geotechnical engineering practices applicable to soil dynamics, foundation design, failure and instability, and other aspects of earthquake ground motion; procedures for integrating information on natural hazards into land-use planning, urban and coastal zone planning, offshore engineering, and siting procedures.
- **Design**—Improved characterization of earthquake and natural hazard loadings necessary for the economical design of structures subject to dynamic loading; new methods of analysis and design of buildings and structures of all types that will take into account nonlinear and inelastic behavior of materials and structures; methods to assess the hazard potential and risk assessments applicable to existing structures and facilities, and to improve performance within economically acceptable bounds; observation of damage to facilities following actual earthquakes, and incorporation of this information into standard design practice; improved computational capability for dynamic analysis of structures and facilities, and improved user access to any computer software developed; model standards and design criteria for design of structures and facilities subjected to earthquake and natural hazard loadings; behavior of smaller nonengineered structures and secondary components of buildings to improve recommended minimum analysis and design guidelines.
- **Policy**—Alternative social adjustments to earthquakes; social, economic, political, legal, and related factors that facilitate or hinder the adoption of both social and technological solutions to earthquake hazards; effective techniques for disseminating information on earthquake hazard mitigation to the public and to decision-makers at the local, State, and national levels; measures that will reduce possible negative social, economic, and political consequences of earthquake predictions and warnings.

Chemical Threats to Man and the Environment

This program supports research to increase our scientific knowledge of manmade contaminants and naturally occurring toxicants and to make this knowledge available to appropriate users. The program emphasizes generic problems and long-range research strategies that mission agencies often find difficult to support because of constraints imposed by immediate regulatory needs or dictated by agency policies. The Chemical Threats to Man and the Environment program encourages innovative research on new and promising ideas falling outside the limited research plans of mission agencies.

During fiscal year 1979, the following specific initiatives will be undertaken:

- Development of enhanced capability to predict the degradation or persistence of representative chemicals in natural environments;
- Correlations of the properties of specific chemicals with their detrimental effects on ecosystems and human populations;
- Development of new insights into the origins and transport of airborne contaminants and the transformations by which they produce secondary toxic products and bioirritants, with special attention to the origins and nature of airborne sulfates;
- Expansion of research on the flux of nitrous oxide from the Earth's surface to the stratosphere;
- Determination of the precursors of carcinogenic nitrosamines to which human populations are exposed, and an investigation of the chemistry of nitrosamine formation and degradation;
- Development of chemical tools and data analysis techniques to identify the sources of pollutants found in the environment;
- Exploration of techniques to predict the likelihood of biological effects of chemicals (before testing on living systems) for use in designing new products and in setting priorities for biological testing.

Alternative Biological Sources of Materials

The Alternative Biological Sources of Materials program seeks to alleviate national dependence on selected scarce resources by making alternative biological sources of materials available in the United States. To achieve these goals, the program supports research to determine which biological sources constitute promising alternatives, to develop biologically based processes needed to convert the sources to useful materials, and to determine the socioeconomic, technical, and environmental impacts of various proposed biological alternative systems on the country. Three particular topics have been selected for investigation: biological conversion of lignocellulosic materials to useful chemicals, biological nitrogen fixation, and production of rubber from the guayule plant.

Community Water Management

The goal of this research program is to reduce risks to public health, safety, and the environment that arise from or are otherwise associated with the use and reuse of water. To achieve this goal, the Community Water Management program seeks to identify threats to community water and assess their effects on public health, safety, and welfare; evaluate existing and new concepts for management of the community water cycle in terms of costs, impacts, effectiveness, and acceptability of risk; synthesize approaches to management of the integrity of community water supplies, with emphasis on conservation, reclamation, and reuse; and improve the process by which knowledge relating to management of threats to community waters is translated into action and public policies.

Intergovernmental Science and R&D Incentives

The objectives of the Division of Intergovernmental Science and R&D Incentives are to facilitate the integration of scientific and technical resources into the activities of State and local governments, and to test and evaluate selected incentives that the Federal Government may use to increase R&D investment in the private sector of the economy and stimulate the accelerated introduction of innovative technology into commercial use. These objectives are carried out through two programs: Intergovernmental and Industrial.

Intergovernmental Program

The Intergovernmental program assists State and local government communities, and the regional and national organizations that represent them, as they investigate alternative approaches that use and integrate scientific and technical resources at these levels of government. Emphasis is placed where possible on institutionalizing and replicating successful approaches and on increased communication among State and local governments in scientific and technology-related matters.

The objectives of the Intergovernmental program are summarized as follows:

- **Local Government**—The establishment of scientific and technological systems in local jurisdictions to further the understanding of science and technology as a major resource in local government problem-solving and to serve as a catalyst for regional innovation groups; the establishment of regional innovation groups for solving common problems with scientific and technical components; the establishment of national innovation networks to facilitate the development of periodic local government R&D agendas, to enhance market aggregation, and to provide communication networks and linkage mechanisms for the regional innovation groups.
- **State Government**—Ways for integrating scientific and technical resources into the policy development and management support activities of individual States; cooperation on a regional and national basis to assist individual States and to address cooperatively common issues; intergovernmental cooperation in the planning and implementation of national research and development agendas.
- **Science and Technology Resources**—National networks of such research organizations as Federal laboratories, universities, private industry, research institutions, and professional associations to foster the exchange of experiences and lessons learned by these resource organizations in their attempts to supply scientific and technical expertise in meeting public sector needs.

Industrial Program

The Industrial program tests and evaluates selected incentives that the Federal Government may use to increase R&D investment in the private sector where new technology is needed in the national interest.

Answers to the question of how science and technology can stimulate economic growth and development are obtained through the study of the entire process of innovation. A major part of the program is an experiment to create a better climate for technological innovation by using a linkage mechanism to join the research capabilities of universities with the research needs of fragmented, traditional industries.

Under a series of recent Regional Research Center experiments, university research capabilities are being used to address industry-identified problems in fragmented industries. Industry-oriented research projects, with emphasis on small business, serve as the basis for an experiment to test the more general concept of Regional Research Centers.

The Industrial program will also support: cooperative experiments to identify barriers and specific incentives necessary to encourage the acceptance of improved manufacturing techniques; methodologies to identify when technologies should be moved out of the laboratory towards commercialization; and incentives for acceptance of sophisticated technologies.

Priority will be given to projects focusing on new complementary relationships between business, especially small business, and universities. Experiments will focus on encouraging private sector research and development and the initiation of new products and processes in support of improved economic performance.

V. Scientific, Technological, and International Affairs

This category of programs combines those NSF activities designed to address a broad range of scientific and technological issues of concern to policymakers. The Division of Policy Research and Analysis and the Division of Science Resources Studies provide data and analysis of national and international issues with significant science and technology policy content. Activity in Information Science and Technology provides support for strengthening fundamental knowledge and the technological base for information science and systems. International Cooperative Scientific Activities support U.S. researchers working with foreign scientists as well as many joint international scientific and technological activities.

Policy Research and Analysis

The Division of Policy Research and Analysis plays a significant role in meeting the need in government for long-term studies and analyses of science and technology policy issues. The objectives of the Division are to:

- Develop an improved knowledge base for science and technology policy research and analysis, including methodology development, testing, and application;
- Summarize and assess the available knowledge and data relevant to specific issues;
- Conduct policy analyses and assess policy options;
- Assist in the assessment of science and technology-related policy decisions.

These objectives are met by extramural research and internal studies under the following programs.

Socioeconomic Effects of Science and Technology

This program supports studies that will make available for Federal decisionmaking improved empirical information on the relationships between science and technology and economic performance and the quality of life, improved information about the effects of government actions on such relationships, and improved methods for generating such information. Research addresses the following questions:

- What are the contributions of private and public investment in science and technology to national, sectoral, and regional economic performance?
- How are economic costs and returns from science and technology distributed?
- What are the benefits and costs to society from technological innovation?
- What are the effects of science and technology on the U.S. private sector's international activities?
- What effects are science and technology having on the well-being of workers and consumers?

Innovation Processes and Their Management

A major objective of this program is to improve understanding of innovation processes in private and public sectors in order to identify leverage points or mechanisms that may be affected by public policies. Research is supported on the following topics:

- Who are the performers of certain functions in the innovation process in specific industries or service areas (e.g., R&D financing, technology transfer, acquisition, use, and evaluation)?
- How do the performers of these innovation functions relate to one another and what factors account for their behavior?
- How do the functions of institutions such as government laboratories, R&D consortia, universities, and industry differ across product and service areas?
- What organizational arrangements and management procedures in Federal agencies are

likely to result in strategies that effectively carry out innovation-related goals?

- What is the role of R&D and technology transfer in the development process of less-developed countries?

Environment, Energy, and Resources Studies

This program seeks to clarify the role of science and technology in improving the Nation's capability to adapt to changes in energy, environmental, and national resource conditions and to contribute to forming policies that may both improve conditions and ameliorate negative effects of changes in them. Research in this area centers on issue definition and assistance to policymakers in finding techniques to deal with critical problems and improved methods for assessing effects of alternative governmental actions. Specific research questions include:

- How can the science and technology knowledge base be improved and more effectively used in decisionmaking?
- What are the linkages among energy, environmental constraints, and the management and use of renewable resources?
- What are the interactions between alternative energy supply options and public policy decisions?
- What flexibilities can be built into environmental strategies to allow for changes in knowledge as science and technology uncertainties are reduced?

Technology Assessment

This program supports assessments of the social consequences of the introduction of a new technology or expansion of existing technologies. Technology assessments are designed to help meet the need for a better informed decisionmaking and policymaking process. These assessments do not, however, specify what to do or how to do it; these determinations are the province of the decisionmaking process.

Support is provided for technology assessments with distant time horizons covering technologies that cut across the responsibilities of individual mission agencies. Studies to improve the methodological state of the art of technology assessments are also supported.

Substantive technology assessments will be sought within four areas: manmade environments; rearrangements of work and social activity patterns; technologies that may affect biological systems; and automation, cybernetics, and information flow.

Methodological studies will focus on improved methods of analysis, including the analysis of decisionmaking under uncertainty; the value of information and cost-benefit analysis; improved forecasting methods; and improved methods to integrate multidisciplinary efforts.

Utilization studies will focus on improving ways to incorporate results into the decisionmaking process.

Eligibility

The work of the Division of Policy Research and Analysis is a cooperative effort involving a group of analysts within the Directorate for Scientific, Technological, and International Affairs and a limited number of grants and contracts with universities and other appropriate organizations.

Study proposals which are responsive to the policy research or analysis issues of the Division are considered for awards.

Profitmaking and other organizations are eligible to participate in the Division of Policy Research and Analysis programs on the same basis as academic and nonprofit organizations.

Deadlines

Proposals may be submitted at any time during the year. Approximately 3 to 6 months should be allowed for review and decision. Letters of interest describing the proposed research are encouraged prior to submission of a formal proposal.

Additional Information

Requests for further information on the specific interests of the program areas should be addressed to the Division of Policy Research and Analysis (indicate specific program of interest), National Science Foundation, Washington, D.C. 20550.

NSF Planning and Evaluation

The Planning and Policy Studies program supports research and policy analysis designed to strengthen the Foundation's ability to plan and improve the management of its activities. A limited number of extramural awards are made to meet the following program objectives:

- Provide information and analysis required by NSF and the National Science Board in assessing problems, evaluating alternatives, establishing priorities, and developing recommendations regarding NSF activities.
- Identify science policy issues and potential problems affecting NSF support of research, including questions of science utilization and NSF relationships with the scientific and industrial communities.
- Document trends in the individual science disciplines and monitor directions in the capabilities of research performers.

Eligibility

A limited number of contract awards are available in areas responsive to the issues stated above. Profitmaking and other organizations are eligible to participate on the same basis as academic and nonprofit organizations.

Deadlines

Proposals may be submitted at any time during the year. Approximately 3 to 6 months should be allowed for review and decision. Letters of interest describing the proposed research are encouraged prior to submission of a formal proposal.

Additional Information

Requests for further information should be addressed to the Planning and Policy Analysis Office, OPRM, or to the Office of Audit and Oversight, National Science Foundation, Washington, D.C. 20550.

Science Resources Studies

Activities of the Division of Science Resources Studies fulfill the legislative mandate of the National Science Foundation Act to "... provide a central clearinghouse for the collection, interpretation, and analysis of data on the availability of, and the current and projected need for, scientific and technical resources in the United States, and to provide a source of information for policy formulation by other agencies of the Federal Government .... " To carry out this mandate, the Division performs:

- Periodic reviews of past and current national R&D funding and the supply and utilization of scientific and technical personnel.
- Short- and long-term projections of R&D funding and of the supply and utilization of scientific and technical personnel.
- Identification and analysis of factors responsible for changes in the science and technology resource system and assessment of their effects.
- Collection, analysis, and dissemination of information on the economic, social, professional, and demographic characteristics of scientific and technical personnel.
- Compilation of information on U.S. and international science and technology resources, their characteristics and dynamics, and development of means to measure science and technology output.

Science Resources Studies activities are performed under the following programs:

Scientific and Technical Personnel

This program supports two related efforts. The first involves data collection activities that include surveys of industry and academic and nonprofit institutions. The second provides for both extramural and staff analytical efforts in areas of significant national interest as related to scientific and technical personnel. Areas to be addressed include improvement in projection methods for the supply and utilization of scientists and engineers.

Funding of Science and Technology

This program provides for the collection, analysis, and dissemination of information on the characteristics and patterns of funding for research and development and for other scientific and technological activities.

Modeling and Special Science and Technology Indicators

This program performs analyses of the dynamics of the science resource system. These include the relationships among elements of the system itself (e.g., assessment of the effect of Federal R&D funding on academic institutions) and the manner in which the total system functions. The studies are designed to provide a continuing overview of the system and to better understand the changes in it over time.

Eligibility

The greater part of the work of this program is performed internally or through contractual agreements with other Federal agencies and other appropriate non-Federal organizations. Special studies are frequently supported through grants and contracts. Thus, unsolicited proposals which are supportive of the program activities are welcomed and are considered for awards.

Deadlines

In general, proposals may be submitted at any time during the year. Program announcements and requests for proposals are issued from time to time for special projects and studies in targeted areas; such solicitations specify deadlines for submission.

Additional Information

A detailed description of the program and copies of reports and publications are available. Communications should be addressed to: Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550.

Information Science and Technology

In fiscal year 1978, NSF refocused its science information activities to increase emphasis on basic and applied information science and to eliminate activities more properly the responsibility of the private sector. Research currently supported is guided by four objectives:

- Contribution to the development of a theoretical and conceptual base from which information science research can proceed in a more systematic manner.
- Development of knowledge leading to improved, more cost-effective, and more easily accessible user-responsive information systems.
- Providing a better understanding of existing information resources and how newer technologies and institutional arrangements can be applied to their improvement.
- Contribution to the provision and analysis of data, performance measures, models, and standards describing the current state, trends, and changes in science and technology information generation, processing, and use.

These objectives are carried out through two interrelated programs: Fundamental and Advanced Research, and Research on Information Systems.

Fundamental and Advanced Research

Fundamental research is directed at refining basic concepts, hypotheses, and explanatory principles that will contribute to a systematically derived theoretical base for information science. Advanced research is directed toward development of potentially more powerful bases for future information transfer systems, with emphasis on those serving scientists and engineers. Research is also supported on the development of descriptive and analytical models of the operation of the U.S. scientific and technical information system. Major issues and questions investigated under the program include:

- What are the critical basic concepts of information science?
- What theoretical models have the greatest predictive power for understanding information transfer processes?
- What conceptual bases offer the greatest potential for organizing question-answering or fact-retrieval systems?
- What are the most effective approaches for applying automation to abstracting/indexing

operations and literature and data compaction—to reduce costs of human processing and allow information services to sift the most significant new items from the ever-increasing volume of literature and data?

- How can the value of information and information transfer processes be measured quantitatively?
- What model or models are most useful for understanding the dynamics of the U.S. scientific and technical information system and for estimating the impacts of changes in components of the system?

Research on Information Systems

The objective of this program is to expand our understanding of the human and technological factors that affect the flow and application of information, including associated social and organizational factors. Research is focused on uses of computer and telecommunication technologies because advances in these fields hold the greatest promise for significant gains in information system effectiveness. Specific areas of research include:

- The use of nonprint media for recording and publishing information.
- The use of computer networks to gain access to recorded information at the point of use, regardless of where the record may be stored.
- Computer assistance in the manipulation, analysis, and interpretation of text and numerical data.
- Collaboration and informal communication among information producers and users by means of computer-based networks.

Eligibility

Institutions eligible to submit proposals are professional scientific and technical societies, universities and colleges, and profit and nonprofit organizations.

Deadlines

Proposals may be submitted at any time. Approximately 4 to 6 months are required to consider a proposal.

PLEASE NOTE: This program does not:

- Provide support for primary publications or monographs.
- Provide bibliographic or reference services or perform literature searches.
- Furnish copies of publications resulting from research sponsored by NSF or other organizations.
- Hire translators or perform translations of foreign publications.

Additional Information

The program annually publishes a program announcement that provides more detailed information on the areas of interest. In addition, from time to time, program solicitations are issued for research on selected, focused problem areas. These may be obtained by writing the Division of Information Science and Technology, National Science Foundation, Washington, D.C. 20550.

International Cooperative Scientific Activities

The Foundation encourages and supports U.S. scientific participation in international science programs and activities that promise maximum benefit to the U.S. science effort.

It is Foundation policy to foster the interchange of information among scientists in the United States and foreign countries, initiate and support scientific activities in connection with matters relating to international cooperation, support basic research abroad (in special cases) as a supplement to the national research effort, and provide support to U.S. institutions for research which is to be conducted abroad.

Programs described in this section are administered by the Division of International Programs (INT) and complement other Foundation activities in support of scientific research and science education. Request brochure number NSF 77-29, *Division of International Programs, National Science Foundation*, for additional information. INT welcomes inquiries about any of the programs listed and encourages U.S. scientists and engineers to discuss with the staff of this Division their plans and new approaches to international cooperation in science.

Cooperative Science Programs

This activity supports projects to enhance communication between U.S. scientists and scientists in selected foreign countries who are at work on related problems. NSF now has bilateral science programs with the governments of 16 countries. These programs have three general goals: to stimulate scientific progress by bringing together creative scientists with similar interests from distant countries or traditions; to improve research in priority areas by sharing in the allocation of personnel and work; and to decrease international tensions and improve mutual understanding with other nations and cultures.

United States-Africa Cooperative Science Program

The National Science Foundation seeks to develop scientific cooperation between Sub-Sahara African and U.S. scientists and scientific institutions for the mutual benefit of the countries involved.

Three types of activities may receive support under this program:

- Cooperative research projects
- Scientific seminars or workshops
- Scientific visits, including travel to plan or confer about scientific activities

Through this program, the Foundation supports the U.S. component of selected cooperative activities, including eligible activities in Africa of scientists from U.S. institutions. In the selection of projects for support, priority will be given to the following areas: resources (plant, animal, mineral, and human), food and nutrition, ecology, and engineering. Criteria for the selection of projects will include their scientific excellence and relevance to important regional or world problems and to specific development goals.

Eligibility

Universities and colleges, professional organizations, and research institutes are eligible to apply for participation. Scientists affiliated with such organizations may apply for support for international travel or visiting scientist activities.

Deadlines

Proposals may be submitted at any time.

Additional Information

Communications should be addressed to: U.S.-Africa Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Australia Cooperative Science Program

The National Science Foundation awards grants to support the participation of U.S. scientists in the United States-Australia Cooperative Science Program. Australian funds support Australian scientists participating in the program.

Three types of projects are supported:

- Scientific seminars or workshops
- Long-term research visits
- Cooperative research

Brochures describing the program and proposal guidelines are available from the Foundation.

Eligibility

Those eligible to submit proposals are academic institutions, professional societies, other private and public scientific organizations, and individual scientists. Individual U.S. scientists must have a doctoral degree or equivalent professional experience. Governmental scientific organizations may also participate but generally have to provide their own funding. An informal inquiry to the Foundation is recommended prior to the submission of a formal proposal. All projects must be approved by the Foundation and the Department of Science in Australia.

Deadlines

Proposals for seminars with dates between July 1 and December 31 must be received by the preceding October 1. Those with dates between January 1 and June 30 must be received by the preceding April 1. For long-term visits with starting dates between April 1 and September 30, the receipt date is the preceding September 1; for those between October 1 and March 31, the receipt date is the preceding February 1. Proposals for cooperative research should be submitted at least 7 months before the desired starting date.

Additional Information

Communications may be addressed to: United States-Australia Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Republic of China Cooperative Science Program

The National Science Foundation awards grants to support the participation of U.S. scientists in the United States-Republic of China Cooperative Science Program. Chinese funds support Chinese scientists participating in the program.

Three types of projects are supported in the program:

- Cooperative research
- Visiting scientists
- Scientific seminars

A brochure describing the program is available from the Foundation, together with guidelines for submitting proposals.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation. The program is aimed primarily at the academic scientist. All projects must be approved by the Foundation and the National Science Council in Taipei.

Deadlines

Proposals may be submitted at any time; approximately 6 months are needed for consideration.

Additional Information

Communications may be addressed to: United States-Republic of China Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-East Asia Cooperative Science Program

This program is designed to support the participation of U.S. scientists in joint projects with their scientific colleagues in Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Cooperative activities on a bilateral basis are encouraged in those areas where both the United States and its partner country will benefit, with the results made available to the international scientific community.

The National Science Foundation coordinates these program activities in the United States and maintains liaison with such participating foreign agencies of the cooperating country as the National Research Council in Thailand and the National Science Development Board in the Philippines.

Three types of activities may receive support under this program:

- Joint research projects
- Joint seminars
- Scientific visits

Each activity requires: (1) approval by the responsible agency in each country; (2) participation by scientists from both countries involved; (3) equitable contributions to the project from the cooperating countries; and (4) support for the costs of participation of its nationals by the respective country.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation.

Additional Information

Communications may be addressed to: United States-East Asia Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550

East Europe Cooperative Science Programs: Romania, Hungary, Czechoslovakia, Bulgaria

These programs are offered to foster and support scientific and technological cooperation on a bilateral basis between the United States and each of the cooperating countries. The programs are conducted and coordinated between the National Science Foundation and comparable organizations in the cooperating countries.

Under these programs, research-oriented cooperative activities may be conducted and supported in any branch of science and technology, including basic and applied aspects of the natural sciences and mathematics, the engineering sciences, and the social sciences, and including interdisciplinary or problem-oriented areas. Support is offered for three types of activities:

(1) Cooperative research—projects designed jointly by, and to be conducted collaboratively between, a principal investigator of the United States and a principal investigator of the cooperating foreign country. Proposals are submitted by American institutions to the National Science Foundation and by the institutions of foreign investigators to the coordinating agencies in their countries.

(2) Seminars—meetings of small groups of scientists of the United States and of the foreign country, jointly designed and convened by American and foreign co-organizers. A seminar may be held in the United States or in the cooperating foreign country. Proposals are submitted by the American co-organizers or their institutions to the National Science Foundation and by the foreign co-organizers through their institutions to the coordinating agencies in their countries.

(3) Scientific visits—visits of short duration for the purpose of planning cooperative scientific activities or conferring about cooperative scientific activities; also, with Romania, visits of longer duration for purposes of research, study, or lecturing. The applications of American scientists to visit one or more of the cooperating countries are submitted by them to the National Science Foundation; the applications of foreign scientists to visit the United States are submitted by them or by their institutions to the coordinating agencies in their own countries.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation.

Additional Information

The brochure *Cooperative Science Programs: Romania, Hungary, Czechoslovakia, Bulgaria; Cooperative Research, Joint Seminars, Scientific Visits* is available from the Foundation.

Communications may be addressed to: East Europe Cooperative Science Programs, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States- France Cooperative Science Program

The National Science Foundation (NSF) and the Centre National de la Recherche Scientifique (CNRS) jointly coordinate the participation of U.S. and French scientists and institutions in the NSF/CNRS Cooperative Science Program.

The objectives of the program are to promote cooperation between scientists of the two countries for peaceful purposes and to provide additional opportunities for them to exchange ideas, skills, and techniques; to attack problems of particular mutual interest; to work together in unique environments; and to utilize special facilities.

Types of projects included in this progam are:

- Exchange of postdoctoral junior scientists
- Cooperative research
- Senior visiting scientists
- Joint bilateral seminars

Each activity in the program involves participation by scientists and institutions of both countries and requires approval by NSF and CNRS.

Eligibility

The exchange of postdoctoral junior scientists is based on an annual competition. Individuals eligible to apply for the postdoctoral exchange program are citizens or nationals of the United States and France who have earned a doctoral degree or its equivalent not more than 5 years prior to the commencement of the exchange visit. Eligible host institutions are, for U.S. candidates, any appropriate French institution. Appropriate institutions are institutions of higher education; government research institutes, laboratories, or centers; and privately sponsored institutes. The period of the exchange visit is between 5 and 15 months. French candidates may obtain information and application materials from the CNRS; U.S. candidates may obtain information and application materials from the address below.

Cooperative research proposals or seminar proposals are developed jointly by U.S. and French scientists and submitted for review to their respective institutions, i.e., CNRS in France and NSF in the United States. U.S. senior scientists may submit proposals to NSF for research visits at French institutions. Such proposals are submitted in accordance with normal NSF procedures.

Additional Information

Communications may be addressed to: United States-France Exchange of Scientists Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-India Exchange of Scientists Program

The National Science Foundation administers the participation of senior U.S. scientists and engineers in a program of short-term exchanges with India for the purpose of increasing scientific communication and collaboration between the two countries. Appropriate activities include the exchange of scientific information, consultation or collaboration on specific projects, and planning future cooperation. In India the program is administered by the Council of Scientific and Industrial Research (CSIR). NSF and CSIR are jointly responsible for approving each exchange visit. NSF pays travel costs of U.S. scientists to and from India. Within India, expenses are covered by the CSIR and the local hosts. A brochure describing this program is available from the Foundation.

U.S. scientists or institutions that wish to invite specific Indian scientists for visits under the provisions of this program may suggest their names to NSF, in addition to encouraging them to make direct applications to CSIR.

Eligibility

Individual senior scientists and engineers are eligible to submit proposals. Requests are evaluated on the basis of the applicant's professional qualifications and the merit of the proposed activity in India.

Deadlines

Applications should be submitted by March 15, 1979, for visits commencing after November 15, 1979, or by September 15, 1979, for visits commencing after May 15, 1980. Processing time, including CSIR concurrence, averages 6 months.

Additional Information

Communications should be addressed to: United States-India Exchange of Scientists Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Israel Binational Science Foundation

The United States-Israel Binational Science Foundation (BSF) came into existence under an agreement between the two Governments, signed on September 27, 1972. The Agreement establishes a program of cooperative scientific research and related activities to be conducted principally in Israel, to be financed with Israeli currency, and involving scientists and institutions of the United States and Israel. Activities must be of mutual interest to the United States and Israel and concerned with science and technology for peaceful purposes.

The BSF is operated with the interest from a fund contributed to equally by both countries. The U.S. contribution represents U.S.-owned Israeli currency, chiefly resulting from payments by the Government of Israel for surplus agricultural commodities sold under Public Law 83-480.

Cooperative Research Projects

The areas currently supported by BSF are agriculture, the natural sciences, the health sciences, science services, the social and behavioral sciences, and such technologies of broad interest to both countries as mass transportation, energy, arid zone, and environmental research. NSF encourages the submission of proposals of high quality which complement or otherwise relate to research supported under NSF programs. Proposals are usually submitted through an Israeli institution, because the awards are made in Israeli currency for work to be performed in that country. Proposals should be submitted by the prospective grantee institution to:

U.S.-Israel Binational Science Foundation
P.O. Box 7677
Jerusalem, Israel

Proposals submitted directly to BSF will later be referred by it to the U.S. Government for comment.

Professor E.D. Bergmann Memorial Research Grants

Two special grants are awarded annually to young scientists, one American and one Israeli, who have completed their doctoral degrees within the last 5 years and who are not on the permanent staff of an institution.

Deadlines

Decisions on awards for cooperative research projects are made in March of each year. To allow sufficient time for evaluation, proposals should reach BSF no later than July 1 of the preceding year. The application deadline for Bergmann grants is November 1 of each year and the awards are made April 1 of the following year.

Additional Information

Inquiries about the preparation of proposals of interest to the National Science Foundation may be addressed:

Division of International Programs
(U.S.-Israel Binational Science Foundation)
National Science Foundation
Washington, D.C. 20550

Single copies of the BSF form "Application for Research Grant," as well as a brochure describing the two programs described above, may be obtained from the same address.

The programs described above are programs of the United States-Israel Binational Science Foundation and should not be confused with National Science Foundation programs. Consequently, institutions and investigators should be aware that standard NSF proposal and award guidelines and procedures are not applicable.

The interests and activities of all scientific agencies of the U.S. Government in BSF are coordinated through the Department of State.

United States-Italy Cooperative Science Program

The National Science Foundation coordinates the participation of U.S. scientists and institutions in the United States-Italy Cooperative Science Program.

The objectives of the program are to promote cooperation between scientists of the two countries for peaceful purposes and to provide additional opportunities for them to exchange ideas, skills, and techniques; to attack problems of particular mutual interest; to work together in unique environments; and to utilize special facilities.

Types of projects included in this program are:

(1) Joint research projects

(2) Exchange of scientists, in connection with approved projects

(3) Seminars to exchange information and plan cooperative research

Each activity in the program involves participation by scientists of both countries and requires approval by the Foundation and by the Consiglio Nazionale delle Ricerche, the executive agencies responsible for carrying out the terms of the agreement in the United States and Italy. Nothing in the agreement is intended to prejudice other arrangements for scientific cooperation between the two countries.

Funds for the support of the activities of American scientists may come from any U.S. source, which includes but is not confined to the regular research support programs of the Foundation. In addition, limited INT program funds are available for the support of visiting scientists, the organization of binational seminars, and for developmental cooperative research grants. Proposals are submitted to the appropriate funding agency or institution in accordance with its normal procedures. At the same time, the U.S. investigators send copies of their proposals to the address below, together with copies of the joint application forms, signed by them and the Italian principal investigators. A brochure describing the United States-Italy Cooperative Science Program is available from the Foundation, together with instructions and guidelines for submitting proposals.

Additional Information

Communications should be addressed to: United States-Italy Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Japan Cooperative Science Program

The National Science Foundation awards grants to support the participation of U.S. scientists in the United States-Japan Cooperative Science Program. Japanese funds support Japanese scientists participating in the program.

Three types of projects are included in the program:

- Cooperative research
- Scientific seminars
- Visiting scientists

A brochure describing the program is available from the Foundation, together with guidelines for submitting proposals.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation. The program is aimed primarily at the academic scientist. All projects must be approved by the Foundation and the Japan Society for the Promotion of Science (JSPS).

Deadlines

NSF and JSPS have agreed to institute one annual deadline for receipt of proposals in each activity of the program, beginning in 1978. These new deadlines are as follows:

- Cooperative Research: March 31 for research that will have starting dates between the following January 1 and December 31.
- Seminars: November 1 for seminars that will take place between the following September 1 and August 31.
- Visiting Scientists: August 31 for visits that have starting dates between the following September 1 and August 31.

Additional Information

Communications should be addressed to: United States-Japan Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Latin America Cooperative Science Programs

These programs are offered to foster and support scientific cooperation on a bilateral basis between the United States and several Latin American countries. The National Science Foundation coordinates the participation of U.S. scientists in these programs under Agreements of Scientific and Technical Cooperation with the appropriate counterpart agencies in the countries involved. Formal agreements for which the National Science Foundation is responsible have been signed with Argentina, Brazil, and Mexico. Other countries in Latin America and the Caribbean are equally considered under informal arrangements.

Under these programs, research-oriented cooperative activities may be conducted and supported in any branch of science, unless specifically limited by mutual agreement between the coordinating agencies. Support is offered for three types of activities:

Cooperative research—projects designed jointly and conducted collaboratively by principal investigators from the United States and from the cooperating foreign country. Proposals are submitted by the U.S. institutions to the National Science Foundation and by the institutions of the foreign investigators to the coordinating agencies in their countries.

Research-oriented workshops—meetings of small groups of scientists from the United States and from the foreign country, jointly designed and convened by U.S. and foreign co-organizers. A workshop may be held in the United States or in the cooperating foreign country. Proposals are submitted by the U.S. co-organizers or their institutions to the National Science Foundation and by the foreign co-organizers through their institutions to the coordinating agencies in their countries.

Scientific visits—visits of short duration for the purpose of planning cooperative scientific activities or conferring about cooperative scientific activities; also, visits of longer duration for purposes of research. The applications of U.S. scientists to visit one or more of the cooperating countries are submitted by them to the National Science Foundation; the applications of foreign scientists to visit the United States are submitted by them or by their institutions to the coordinating agencies in their own countries.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation.

Deadlines

Proposals for cooperative research and seminars should be submitted by either June 1 or December 1. Processing time for proposals averages 7 months. Proposals for scientific visits should be submitted 3 months in advance of the desired departure date.

Additional Information

Communications should be addressed to: United States-Latin America Cooperative Science Programs, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Republic of Korea Cooperative Science Program

The purpose of the U.S.-Republic of Korea Cooperative Science Program is to increase the effectiveness of the interaction of the U.S. and Korean scientific communities. To achieve this objective the program supports:

- Research visits of U.S scientists who spend 6 to 12 months with a Korean host institution.
- Short-term visits necessary to develop cooperative research projects.
- Cooperative research projects.

U.S. and Korean scientists may wish to consider application to the program for approval of their proposals when special benefits can be expected from collaboration—sharing of unusual facilities and research environments, joining of complementary skills in experimentation and theoretical analysis, combined use of resources in solving problems of common concern, and similar unique combinations of talents and resources.

Guidelines on proposal preparation are available from the Foundation. Korean scientists should contact the Korea Science and Engineering Foundation (KOSEF), P.O. Box 124, Cheong Ryang 130, Seoul.

Eligibility

U.S. universities and colleges, professional societies, research institutes, and individual scientists employed by such organizations are eligible to apply for participation. All projects must be approved by the Foundation and KOSEF.

Deadlines

Proposals should be submitted as far in advance as possible of the starting date of a proposed visit or research project. At least 6 to 8 months is required for review of a proposal.

Additional Information

Communications may be addressed to: United States-Republic of Korea Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-New Zealand Cooperative Science Program

The National Science Foundation considers proposals from U.S. scientists for cooperative activities with New Zealand scientists in areas other than energy (energy-related activities are coordinated by the Department of Energy's Office of International R&D Programs). New Zealand funds support New Zealand scientists participating in the program.

Two types of research visits, short-term (including cooperative research) and long-term, are considered for support. Seminars and workshops may also be organized in special circumstances. Guidelines for the preparation of proposals are available from the program. An informal inquiry to the Foundation is recommended prior to the submission of a formal proposal.

Eligibility

U.S. universities and colleges, professional societies, research institutes, other private and public scientific organizations, and individual scientists employed by such organizations are eligible to apply for participation.

Deadlines

Proposals for long-term collaborative research visits with starting dates between June 1 and November 30 must be received by the preceding October 1. Proposals for visits with starting dates between December 1 and May 31 must be received by the preceding April 1. Cooperative research proposals are due at least 7 months before the desired starting date. Those wishing to organize a seminar/workshop should inquire at least a year before the planned dates. Proposals for seminars/workshops with dates between July 1 and December 31 must be received by the preceding October 1. Those with dates between January 1 and June 30 must be received by the preceding April 1.

Additional Information

Communications should be addressed to: United States-New Zealand Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

Other International Programs

Scientific Organizations and Resources

Activities under this program are designed to enhance the effectiveness of U.S. participation in selected international scientific organizations. U.S. participation is designed to promote needed cost sharing and task sharing among participating countries and to keep U.S. scientists informed about scientific work abroad. In addition, U.S. national committees for these organizations and study groups make assessments of international programs. The program also supports the direct participation of qualified U.S. scientists in important multilateral projects.

Eligibility

Institutions which meet the criteria for membership in international nongovernmental scientific organizations, and which can provide the necessary support services to U.S. national committees for the organizations, are eligible.

Additional Information

Communications should be addressed to: Scientific Organizations and Resources Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

Scientists and Engineers in Economic Development (SEED) Program

The National Science Foundation, through a special program jointly funded with the Agency for International Development (AID), will provide support for individual U.S. scientists and engineers to apply their experience to problems of development in 43 countries currently receiving assistance from AID.

The program's objectives are to enable U.S. scientists and engineers to share experience with their counterparts in developing countries in the conduct of specific research and education programs contributing to development; establish long-term collaborative relationships between U.S. and foreign institutions; and increase the capability of scientific and technical institutions in developing countries.

Types of awards included in this program are:

(1) Research/Teaching Grants—Individuals may apply through their institutions for support to enable them to conduct research or teach for 5 to 12 months in academic institutions of developing countries. Grants may provide stipend plus air travel allowance for the scientist and two dependents. Local costs in the foreign country must be met by the host institutions.

(2) International Travel Awards—Individuals may apply for International Travel Awards to engage in research or teaching in institutions of developing countries for a period less than 5 months. Awards will consist of open, full-fare, economy class, round trip tickets from point of origin to destination. Per diem and local costs must be provided by the host institution.

Eligibility

Applicants are limited to scientists and engineers from U.S. academic institutions with at least 5 years of postdoctoral or equivalent experience in teaching or research and who will return to their institutions on completion of the project.

Proposals will be considered in the following fields: engineering, physical sciences, earth sciences, biological sciences, social sciences, and science education.

Applications for travel support may be submitted at any time. The closing dates for submission of Research/Teaching proposals are June 1 and December 1. Approximately 6 months are required to process applications.

Additional Information

Communications should be addressed to: Scientists and Engineers in Economic Development Program, Division of International Programs, National Science Foundation, Washington, D.C. 20550.

Special Foreign Currency Programs

The National Science Foundation makes awards to support scientific activities overseas which will incur costs payable in the currencies of Burma, Egypt, Guinea, India, and Pakistan. These awards are in two categories: grants for research, science education, and related activities; and contracts for procurement of scientific and technological information. They utilize foreign currencies which the Treasury Department has determined to be in excess of the established requirements of the United States.

Research, Science Education, and Related Activities—Three main classes of activity are included in this program: cooperative research and science education projects, international travel, and visiting scientist activities. A principal purpose of the program is to obtain for scientists and institutions of the United States the benefits of cooperation with their counterparts in participating countries. In addition, the program provides support for cooperative projects under the U.S.-Egypt and U.S.-India Joint Commissions.

The Foundation brochure, *NSF Special Foreign Currency Program, Support for Research, Science Education, and Related Activities, Information for U.S. Scientists*, describes the classes of activity supported and provides other information. A companion publication, *Information for Scientists in Participating Countries*, is also available. The program provides necessary *supplemental* dollar support to U.S. institutions for activities which directly enhance the benefits of U.S. participation; requests for *principal* dollar support by U.S. institutions may be included in proposals for consideration by other program offices of NSF.

Foreign Science Information—In fulfilling its responsibility for coordinating the needs of U.S. Government agencies, the Foundation contracts with organizations in participating countries for delivery of scientific and technological information to the United States. Contracts cover translating, abstracting, indexing, reviewing, and publishing in English significant foreign scientific literature. The preparation and publication of surveys, directories, guides, and other reference aids on foreign scientific and technical information resources—literature, institutions, scientists—is also undertaken under contract.

The following sections on eligibility and deadlines refer only to *Research, Science Education, and Related Activities*.

Eligibility

Universities and colleges, professional organizations, research institutes of either the United States or the participating countries, and individual scientists employed by such organizations are eligible to apply for participation.

Agreement on the objectives, content, and scope of a cooperative project should be reached by U.S. and foreign scientists before they submit proposals. Consultation or correspondence with the Division of International Programs by prospective U.S. or foreign proposers prior to submission of a formal proposal is recommended. Formal proposals should be prepared in accordance with the requirements outlined in the relevant NSF brochures. Project proposals to be funded in foreign currency must be approved by the government of the participating country; the scientific institution in that country which is cosponsor of the project initiates the request for approval.

Deadlines

Proposals for activities to be funded by foreign currency may be submitted at any time. Approximately 8 months are required to consider a project or visiting scientist proposal after foreign government clearance is received; 5 months are required to consider a proposal for an international travel award that includes per diem; 4 months are needed under International Travel Support (ticket only; see below).

Proposals for the support of costs of organizing a conference or symposium should be submitted 8 to 12 months in advance to allow time for the organizer to inform key participants concerning the NSF decision.

Additional Information

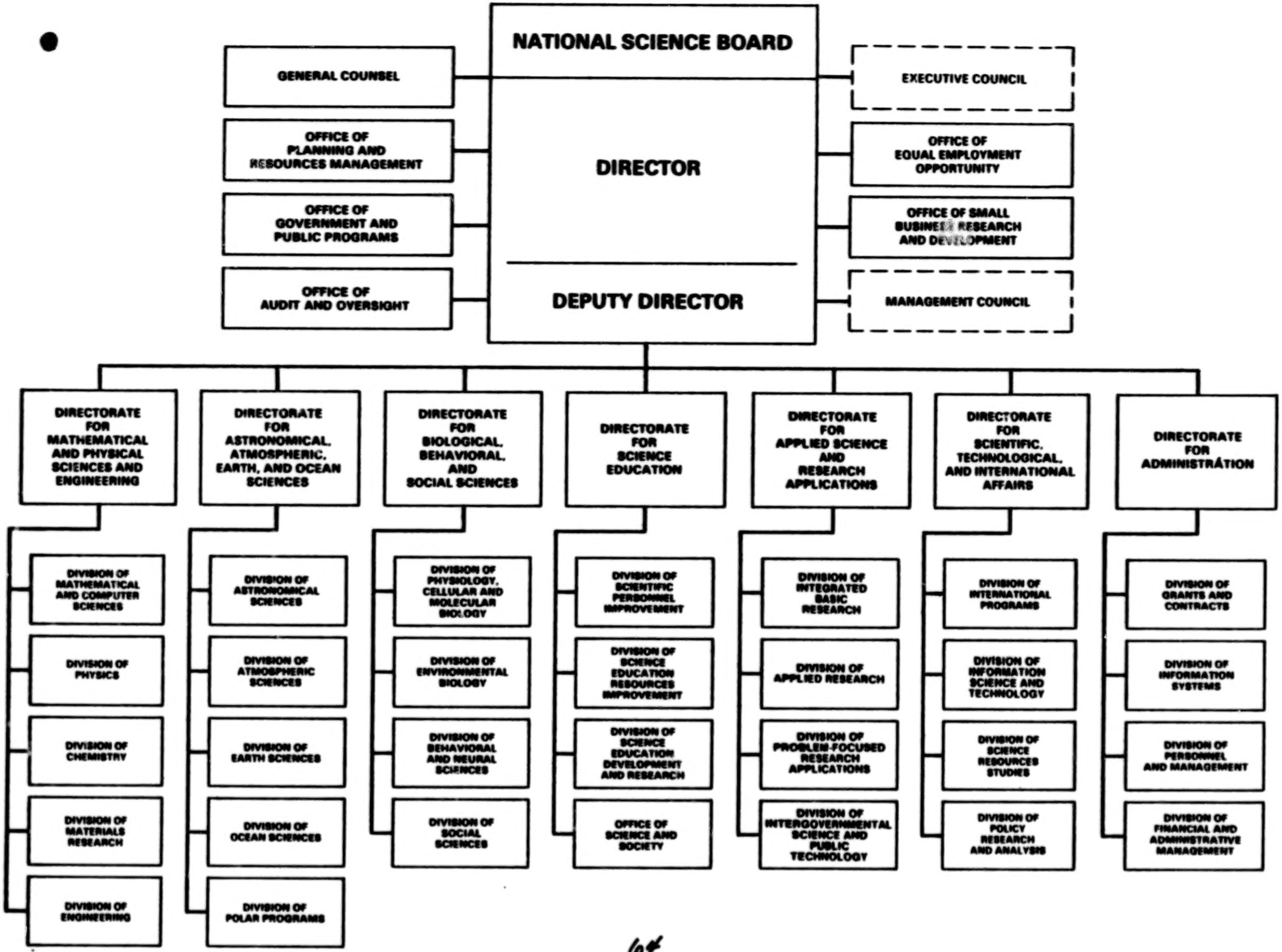
Communications should be addressed to: Division of International Programs, National Science Foundation, Washington, D.C. 20550.

Requests for information about the availability of materials produced under the Foreign Science Information program should be addressed to National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151.

These programs are managed by the Directorate for Scientific, Technological, and International Affairs.

International Travel Support Program

The National Science Foundation supports international travel to assist scientists to go abroad. The guidelines for this program are being revised and will be published in a new program announcement, which may be obtained by writing to International Travel Support, Division of International Cooperative Scientific Activities, National Science Foundation, Washington, D.C. 20550.


NATIONAL SCIENCE BOARD
DIRECTOR
DEPUTY DIRECTOR
GENERAL COUNSEL
OFFICE OF PLANNING AND RESOURCES MANAGEMENT
OFFICE OF GOVERNMENT AND PUBLIC PROGRAMS
OFFICE OF AUDIT AND OVERSIGHT
EXECUTIVE COUNCIL
OFFICE OF EQUAL EMPLOYMENT OPPORTUNITY
OFFICE OF SMALL BUSINESS RESEARCH AND DEVELOPMENT
MANAGEMENT COUNCIL
DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING
DIVISION OF MATHEMATICAL AND COMPUTER SCIENCES
DIVISION OF PHYSICS
DIVISION OF CHEMISTRY
DIVISION OF MATERIALS RESEARCH
DIVISION OF ENGINEERING
DIRECTORATE FOR ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES
DIVISION OF ASTRONOMICAL SCIENCES
DIVISION OF ATMOSPHERIC SCIENCES
DIVISION OF EARTH SCIENCES
DIVISION OF OCEAN SCIENCES
DIVISION OF POLAR PROGRAMS
DIRECTORATE FOR BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES
DIVISION OF PHYSIOLOGY, CELLULAR AND MOLECULAR BIOLOGY
DIVISION OF ENVIRONMENTAL BIOLOGY
DIVISION OF BEHAVIORAL AND NEURAL SCIENCES
DIVISION OF SOCIAL SCIENCES
DIRECTORATE FOR SCIENCE EDUCATION
DIVISION OF SCIENTIFIC PERSONNEL IMPROVEMENT
DIVISION OF SCIENCE EDUCATION RESOURCES IMPROVEMENT
DIVISION OF SCIENCE EDUCATION DEVELOPMENT AND RESEARCH
OFFICE OF SCIENCE AND SOCIETY
DIRECTORATE FOR APPLIED SCIENCE AND RESEARCH APPLICATIONS
DIVISION OF INTEGRATED BASIC RESEARCH
DIVISION OF APPLIED RESEARCH
DIVISION OF PROBLEM-FOCUSED RESEARCH APPLICATIONS
DIVISION OF INTERGOVERNMENTAL SCIENCE AND PUBLIC TECHNOLOGY
DIRECTORATE FOR SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS
DIVISION OF INTERNATIONAL PROGRAMS
DIVISION OF INFORMATION SCIENCE AND TECHNOLOGY
DIVISION OF SCIENCE RESOURCES STUDIES
DIVISION OF POLICY RESEARCH AND ANALYSIS
DIRECTORATE FOR ADMINISTRATION
DIVISION OF GRANTS AND CONTRACTS
DIVISION OF INFORMATION SYSTEMS
DIVISION OF PERSONNEL AND MANAGEMENT
DIVISION OF FINANCIAL AND ADMINISTRATIVE MANAGEMENT